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By W. F. Netzeband

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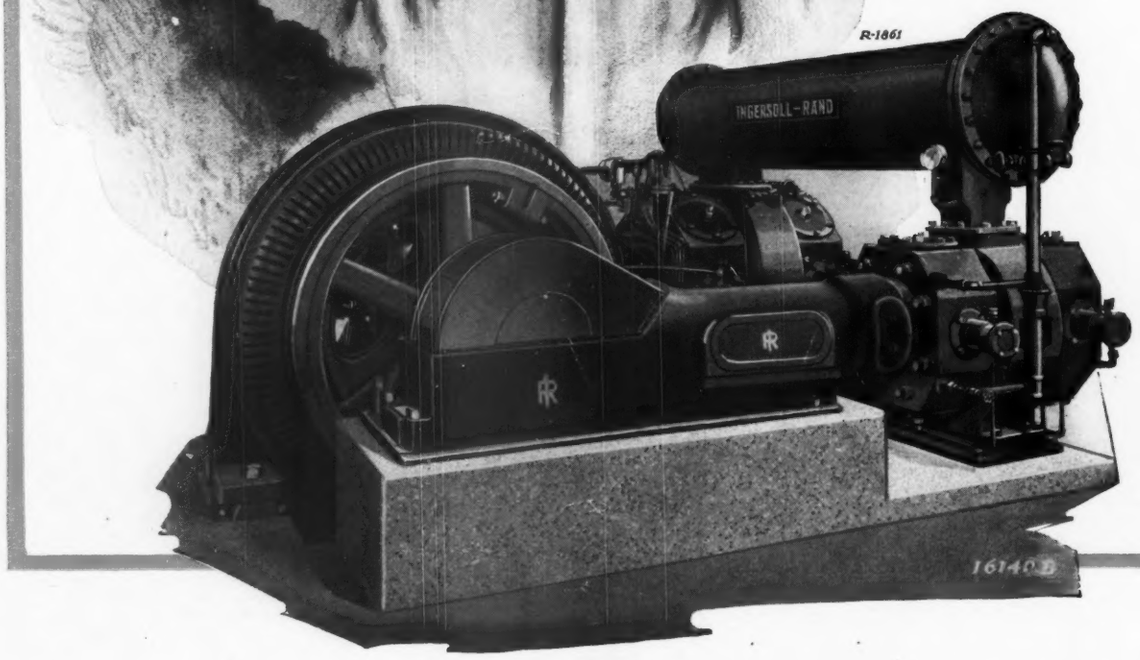

Volume 127

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A consolidation of "Engineering and Mining Journal" and "Mining and Scientific Press"

A. W. ALLEN, *Editor*

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New York, May 18, 1929

Features of *E.&M.J.*: VIII—Consultation

THOUSANDS of inquiries are directed to the editorial staff of *E.&M.J.* every year for information on almost every conceivable topic allied with the mining industry; and sometimes, even, with no apparent connection. Questions as to marketing possibilities for various products are particularly frequent. This opportunity of tapping the editorial files is no small part of the service many subscribers receive. No charge is made except when an unusual amount of time is required for research. Questions and answers of general interest are published under the head of "Consultation," the inquirer's name being omitted to avoid possible embarrassment.

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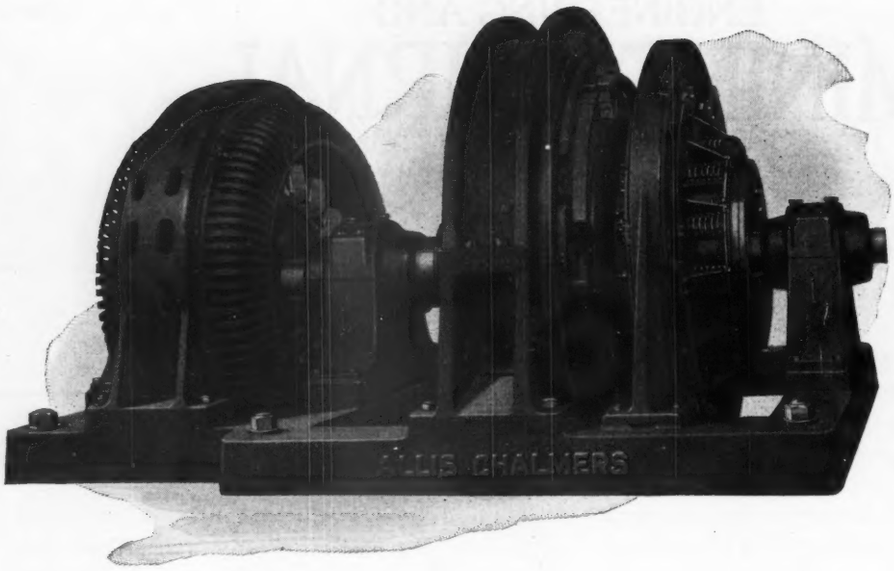

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English Becomes the Universal Technical Language

CECIL RHODES believed that the misunderstandings arising from language barriers provide the greatest obstacle to world peace. When the Emperor of Germany made the teaching of English compulsory in German schools, the great British empire builder revised his will and added Germany to the English-speaking nations that were to benefit from scholarships at Oxford. Soon after the outbreak of the war his Britannic Majesty's Privy Council revised the Rhodes will and excluded Germany from its benefits. If the wishes of a dead statesman are to be respected, surely it is time that these opportunities and privileges be restored.

Prior to the war the business of diplomacy was the only branch of human affairs that had adopted a universal language—French. With the growing participation of the United States in world affairs, caused by its entry into the European conflict and the part it has since played in post-war adjustment, English has taken the place of French as a medium for the international exchange of views. Germany has made a valiant attempt to insist that German is the language of science; and the influence of German teachers in the United States is responsible for the assumption that a knowledge of chemistry, if not also of physics, is impossible to acquire without a knowledge of German, with the result that students in those sciences are still obliged to struggle with that cumbersome and awkward language. However, the acquisition of a reading and speaking knowledge of English by Germans in Germany has proceeded at a much faster rate than has the acquisition of German by Americans in the United States; and indications point to the fact that English is destined to be the universal language of science and technology.

The establishment of a virile and progressive technical press in the United States is responsible to a large extent for this tendency. *Engineering and Mining Journal,* for instance, circulating in all countries where mining and metallurgy are practiced, is helping to bring about the acceptance of English as the engineering language of the world. The time has come when a knowledge of it is essential to anyone, in any country, who is responsible for the adoption of progressive ideas and who is expected to possess a comprehensive knowledge of the major world advances in research and invention. The mail received by the editor of an international publication such as *Engineering and Mining Journal* offers ample proof of the fact that a knowledge of the English language is spreading throughout the civilized globe.

Received in this office recently was a copy of an "English-Russian Mining and Metallurgical Glossary," compiled by Dr. N. I. Truschkoff, professor of mining at the Leningrad Mining Institute. This is a dictionary that translates only English technical terms into Russian, and not the reverse. It was evidently compiled to help Russian engineers in their efforts to read the leading technical journals published in the English language. With a knowledge of the increasing dependence being placed on the overseas technical press by those who are outside the British-American group, it behooves us to see that high standards of journalism are maintained.

Manganese Tariff Schedule Reported to the House

CONTINUANCE of the protection given domestic manganese by the Tariff Act of 1922 is provided in the new bill reported to the House on May 9 by the Ways and Means Committee. Thus again, after seven years, and in spite of hostile opinion and influence, recognition is given of the desirability and need of developing within the nation's borders a domestic manganese industry that will serve the country's steel industry in time of peace and safeguard it in time of war.

Protection in the increased degree sought by the domestic industry is not provided in the bill, however. The committee, by granting continuance of the duty of one cent per pound metallic manganese on ores containing over 30 per cent manganese, and at the same time refusing the additional half-cent duty asked for, has split the difference, so to speak, between the manganese interests and the steel producers.

Justification of the request for an increase of half a cent in the duty can readily be seen. This increase was not sought with the idea that to keep the protection they already enjoyed the manganese producers must ask for a duty greater than one cent per pound. Rather, they hold that the higher rate is just sufficient to guarantee a market price of 66.6 cents per unit for 50 per cent manganese ore delivered at Pittsburgh, or one cent less than the average price paid for foreign ore of the stated grade in the five-year period ended January 1, 1929, according to the Tariff Commission's figures. Thus, if the additional half cent were granted, domestic consumers would still be able to buy domestic manganese for less than they have been paying for imported ore.

The benefit that the increase would bring to domestic producers is evidenced by the fact, attested to by the American Manganese Producers Association, that during the same five-year period they have not been paid or offered more than 60 cents per unit for ore of the

grade described, delivered at the same or equivalent point. In other words, they have been refused a fair price for their ore.

The controversy now passes to the House and Senate. Rarely has Congress been called upon to consider a tariff schedule of such peculiar importance as that of manganese. Fortunately, the merits of the case are better understood today than they were formerly. Fair treatment of the producers is expected.

Mass-Production Methods and the Future

TWO BROTHERS, officers of the same company, discuss the subject of mass production from opposing points of view in the May issue of *The Atlantic Monthly* and present not only an unusual and interesting debate, but, more important, food for thought on the part of business and industry both in this country and in other countries.

The debate is in the form of two articles, one written by each of the two brothers. In presenting the opposing claims generally held for and against mass production, brother A. L. Filene, of the firm of William Filene's Sons Company, first points out that, among the new methods employed by business, mass production has created the greatest popular interest. By reducing the price of goods, and at the same time raising wages, many have contended that poverty will be removed from the world. Others have asserted that the practice will spread throughout the industrial world, enslaving man to the machine and so imposing a spiritual poverty more serious than material want. In opposing mass-production methods, he claims that utility, uniform quality, and low prices are, generally, the grounds on which manufacturers of standardized products made in quantity expect the public to spend its money, and that this expectation no longer has its old-time validity for many products. Style has become so marked a factor in recent years in the production and marketing of goods that the present might as properly be termed an era of style as an era of mass production. A great share of the savings in the cost of mass-production manufacture has been lost in increased cost of sales. The menace of overproduction is constantly dogging the heels of mass production, and the development of exports to the extent necessary to absorb surplus capacity is, in consequence, mass production's next hurdle.

Numerous social problems are threatening the system from without. The wholesale application of power and machinery has resulted in forcing large numbers of workers out of employment, even though, theoretically, continual lowering of the cost of a product through the introduction of labor-saving machinery should result in greater consumption, and hence keep employment fairly stable over a long period. In summary, this brother contends that mass production is not destined, as was once expected, to be the undisputed sovereign of American industrial life. If it is to move forward successfully in the future, he holds, it will do so only after careful study of economic and social problems which it is creating and which it must solve.

But brother E. A. Filene, after crediting to competent observers in the United States and Europe the deduction that America's increasing general prosperity and high standards of living are due chiefly to rapidly increasing use of scientific mass production and distribution, says that, even so, some—mostly impractical theorists—profess to see in mass methods the threat of grave danger to mankind. Where he sees the means of liberating the masses of the people economically, the critics of mass methods see the probability that men will become veritable slaves of their machines. In short, the theorists assert that mass production and distribution are bad in many ways for both producer and consumer. He is convinced that they benefit both.

Then follow analyses attacking the validity of the critics' contentions, setting forth that mass production, by reducing costs and prices and by increasing wages, has increased purchasing power. Increase in per-capita consumption has kept pace with the increase in per-capita production, so that, in the long run, mass production has not resulted in unemployment. Specialization should not be thought of as standardization, or standardization as implying that only a single style, design, or variety of any product will be made. Mass production enables better artists to be employed for designing a product. Expensive high-pressure methods are not necessary to sell wanted goods to people who have sufficient money with which to buy them. And, in summary, this second brother observes that business, to succeed largely in these days, must produce in large quantities, pay high wages, and sell cheaply. The basis of prosperity, he holds, is the buying power of the masses, which has been created by scientific mass methods in production and distribution.

Aside from other observations, it is evident that the aforesaid firm enters the business future with both eyes open, and that, assuming a leavening influence of common sense in its management, the company should reach a satisfactory solution of the complex problem presented, so far as it applies to the business of that company. Serious consideration of the problem on the part of other businesses and industries would seem advisable, for certain it is that mass production is of vital concern to all. An intelligent understanding and weighing of the factors involved is the best safeguard to continued economic and social progress in the days ahead.

Phelps Dodge Is Introduced to the Investing Public

UNTIL NOW, Phelps Dodge has been one of the few prominent American copper-mining companies the shares of which have not been traded on the leading New York or Boston stock exchanges, so the listing of two million shares on the New York Stock Exchange last week is notable. Of the larger companies, only United Verde is virtually a closed corporation, this company having, it is understood, only twenty or so stockholders, and no shares being available even in the open market. Of the other prominent producers, Noranda and United Verde Extension are traded on the New York Curb market—an arrangement that seems likely to persist for U.V.X., as the expected life of its present orebody is limited to a few years. For Noranda, however, as it becomes a more powerful

factor in the copper world, a transfer of its listing to the New York Stock Exchange would seem to be logical. The Michigan coppers—Calumet & Hecla, Copper Range, Isle Royale, Mohawk, and Quincy—have either had their financial offices in Boston or have made their chief appeal to New England investors, so that trading in their securities has naturally centered in that city.

Phelps Dodge Corporation is now twelve years old, having been formed in 1917 when the old firm of Phelps Dodge & Company was reorganized. The securities were almost entirely held by members of the families who founded the company. A gradually increasing amount of the stock was traded on the "over the counter" market, however, so in 1920 *Engineering and Mining Journal* began publishing bid and asked quotations as a guide to the value of the company's securities. More recently, occasional dealings took place on the New York Curb Exchange. Liquidation of the holdings of Arizona Copper, a Scotch company that acquired Phelps Dodge stock when its holdings at Clifton and Morenci, Arizona, were absorbed by the corporation, has thrown two hundred thousand shares of Phelps Dodge stock on the market, through Hornblower & Weeks, with the listing of the stock a logical consequence.

No organization in America has a better reputation among mining engineers than has Phelps Dodge, and a high respect for the company extends even to rival marketing organizations and to consumers of its copper. Operations are intelligently conducted, and no one can visit its plants in the Southwest without sensing the admirable spirit that pervades the personnel. The great investing public is to be congratulated on this opportunity to participate in the business of America's third most important copper-producing company.

Bridge Failures Reveal Inadequacy of Preliminary Research

AN ADEQUATE AMOUNT of research should be undertaken well in advance of plant or building construction. The need to provide an ample factor of safety and to be in a position to forecast maximum construction and maintenance expense involves the employment of every precaution known to science. In spite of preachments and warnings, however, disasters occur in practice that reveal the inadequacy of preliminary research, especially when a departure from normal engineering and construction practice has been sanctioned.

In this category may be placed the recent failure of the cables on the Mount Hope suspension bridge, almost completed, near Bristol, R. I., and of those on the Ambassador bridge being erected at Detroit. A new type of cable was used for both bridges—composed of heat-treated galvanized wire, instead of the cold-drawn wire heretofore employed in such structures. The substitute, presumably, was thoroughly tested prior to its adoption and was approved by recognized bridge engineers. Nevertheless, the wires began to break under less than full load. Cables of both bridges are to be replaced. The Detroit bridge is 7,400 feet long, including a suspended central span of 1,850 feet, and in point of span it ranks second only to the Fort Lee bridge now under erection across the Hudson. Reconstruction of the bridge will involve the replacement of about 11,000 miles of steel wire. Changes at the Mount Hope bridge, which is 2,648 feet long and has a main span of 1,200 feet, will cost three-quarters of a million dollars. In both instances the delays caused will add to the expense of a costly change from accepted practice. Such are the principal facts in the first serious failure of bridge suspension systems in modern times.

The breaks in the cables have been referred to in the technical press as sensational, surprising, mysterious. This is clearly a challenge to metallurgical research, as well as adequate proof of the incompleteness of current knowledge regarding the performance of metals. Research, and research alone, will reveal ultimately the reason for the wire-breaks in the cables, as in other instances it has explained the variance between the performance of a new concentrator and the results achieved in a pilot plant. To it, therefore, practice must look for guidance, and for aid in the solution of other engineering difficulties.

What Are the Possibilities for Harder Alloys?

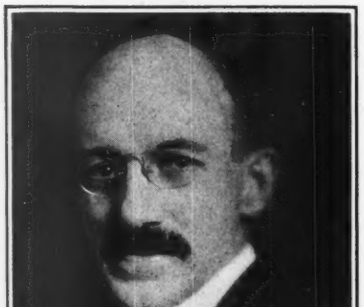
ONE of the least exploited physical properties of metals, alloys, and related materials is that of hardness. Fundamental pioneering research is promising of results. Investigators have struggled with the meaning of the terms hardness, toughness, and brittleness, with the result that their significance is generally understood, but physical measurement has been difficult. Nevertheless, various approximate standards and methods of measurement are now in common use.

Is there any material harder than the diamond? Not so far as known. Can a harder material than the diamond be prepared artificially? Perhaps it can. If it could, great possibilities might be developed for its use. Here is an adventurous field in research, for the discovery of harder and tougher substances than any of which we now know.

Henri Moissan pioneered in the making of carbides, silicides, and borides. Since Moissan's work, much research in high-temperature products has taken place. The brittle tungsten carbide, known for a long time to be a hard material, when combined with cobalt became of great interest. Its hardness is stated by S. L. Hoyt to be approximately 2,100 to 2,500, compared to the Brinell number of 1,000 for the hardest steel. On the Mohs scale it is between the diamond and emerald.

This, and similar new hard metals that may be developed, should have a marked effect on the machining of metals and other materials, and will advance this art over its present position, attained with the introduction of high-speed steel alloys. Application to oil-well drilling tools has also been made. Incidentally, for the tungsten and cobalt miner the alloy mentioned will afford a wider market for his product, and new discoveries may well afford new outlets for other of the rarer metals. The possibility of developing still harder materials should stimulate the efforts of those engaged in metallurgical research.

Is There a Serious Shortage of Mining Engineering Students?



By E. A. HOLBROOK

Dean of the Schools of Engineering and Mines, University of Pittsburgh, Pittsburgh, Pa.

ENGINEERING AND MINING JOURNAL is particularly fortunate in being able to present the following article at this time, when considerable attention is being directed toward engineering education. The subject is of vital importance to the mining industry, not only for the moment, but also in adequately providing for the future. From both an academic and a practical standpoint the author is exceptionally well qualified to discuss the question; his views should contain much of value to the mining industry.

Mr. Holbrook graduated from the Massachusetts Institute of Technology in 1904 and received the honorary degree of engineer of mines from the University of Illinois in 1916. After several years of practical work as superintendent of mining companies in Montana, Mexico, and Canada, he accepted a professorship in mining and metallurgy at the Nova Scotia Technical College, and a few years later was professor of engineering at the University of Illinois. At the outbreak of the war he entered the service of the U. S. Bureau of Mines, becoming assistant director of the Bureau in 1920. He went to Pennsylvania State College in 1922 as dean of the School of Mines and Metallurgy, and in 1927 assumed his present duties at the University of Pittsburgh. Dean Holbrook is also chairman of the Committee on Engineering Education of the A.I.M.E. His article follows:

* * * *

THE study of the present enrollment in mining engineering at our colleges presented by H. D. Keiser in brief at the February meeting of the American Institute of Mining and Metallurgical Engineers, and in full in this journal in the March 30th issue, has aroused considerable interest and discussion as to the future of mining engineering, not only among those of us who are engaged in educational work but among the general profession and in the employing mineral industries. The study showed that only about 200 young men will graduate this year from the forty-two mining schools and college departments of mining engineering in this country. This is less than one-third of the number graduating a few years ago. As far back as 1893 (*Trans.* A.I.M.E., Vol. 36, p. 450), Professor Christy, of the University of California, estimated that at least 200 graduates per year were necessary to keep up our supply of mining engineers without allowing for any increase in the industry.

Was the supply formerly so much greater than the demand? Are we graduating enough now to supply both the coal- and metal-mining industries of this country and also send our usual quota to foreign countries, or are the mineral industries going to be in difficulties within a few years because of the lack of trained young men? Are our mineral industries now so organized that the need for trained men is less than formerly? These and similar questions demand our consideration. One general answer to the questions has been given by a number of educators, who claim that the enrollment of our mining schools is not decreasing, and point to statistics of enrollment to prove their point. However, an analysis of enrollment shows that certain of the mining schools are admitting students in civil, mechanical, electrical and other non-mining courses. Moreover, some mining schools classify students that are enrolled in courses of metallurgy, geology, oil and gas, and ceramics as being under the general heading of mining engineering.

Most of us consider a course in mining engineering as a very definite training, based upon English, geology, chemistry, physics, and mathematics, and giving a student a point of view that will fit him into the mining industry as an operating or a technical man, qualified after gaining practical experience, to develop and operate mines, and to meet the varied engineering and human problems that arise in this field of endeavor. He is not first of all a geologist, a mechanical engineer, or a petroleum engineer—he is a mining engineer, looking forward to a life work in one of the oldest of the established engineering professions—mining engineering, the science and art of economically extracting minerals from the ground, and if needs be of better preparing them for subsequent use. Mr. Keiser's article has brought out conclusively that our mining schools within the last five years have had a greatly decreased enrollment of students who were preparing themselves for this type of work.

In order to see clearly the present situation in mining

engineering it is necessary that we have a comparison, a background that will make our present picture stand out more clearly. This background is the past development of the profession. Mining has always been an industry apart and dissociated from other industries, partly because of its location and partly because of the special training in underground conditions needed by those who followed it. As far back as recorded history goes, mining has been an industry which had to function before the rest of the world could go forward. Mining has always been an art; its development as an organized science is of comparatively recent origin.

The first engineering school[1] of which there is record was the École des Ponts and Chaussées, at Paris, which began to function about 1747, but which was not legally organized until 1775. This school trained what we would call civil and military engineers. The first school of mines was the Royal Bergakademie, organized at Freiberg, in Saxony, in 1778, for the teaching of mining and metallurgy. The second was the École des Mines, of Paris, authorized by King Louis XIV as a public and gratuitous school of mineralogy, assaying, and metallurgy. Thus from the very beginning of our modern notions of engineering and engineering education, the mining school was recognized as necessary to train men for the peculiar technology of mining. It is well to remember that at this time there were no professions of mechanical engineer, electrical engineer, and the other more recent branches. The military engineer and the civilian or civil engineer filled the engineering needs of the day, excepting in mining, where the need of specialized training had been recognized. Historically, then, it appears that the position of the specially trained mining man or mining engineer is secure.

In France, in 1783, an official corps of "Ingeniurs des Mines" was created to foster and regulate the mineral industry of France. The Convention of 1802 suppressed the École des Mines, but the Restoration created an École des Mineurs at St. Etienne and the École des Mines at Paris.

The École des Mines has held consistently to lofty scientific principles and made no effort to simulate industrial operations, holding that they must be learned at the mines. The first school of mines in England was the Government School of Mines established in London in 1851, "In response to numerous memorials from the mining industry."

The first American school of mines was established at Columbia University in 1864. It was modeled on the École des Mines, and in turn furnished the model of which most of our American schools of mines have been built. The indirect influence, however, of the old Bergakademie, of Freiberg, on our American mining schools, and indeed on our whole modern system of engineering education, has been very great. "It deviated from the universities in combining theoretical teaching with practical work in laboratories, inspection of mine workings, journeys of observation, and actual work in technical callings. These methods were here originated."

At the time the Columbia School of Mines was established, the colleges of this country giving engineering courses could be fairly counted on the fingers of one hand. So that mining engineering instruction in this country has its roots deep in the soil from which sprang our present crop of engineering schools and their diversified courses. Massachusetts Institute of Technology was the second school in this country to establish a course in mining engineering. Then during the years from about 1880 to 1900 a considerable number of mining schools and departments were established throughout the country, especially in states where there was a going or a potential mining industry. The number of mining schools or mining departments has since increased gradually, until today there are in the United States about forty-five schools or departments of collegiate rank, offering courses in mining engineering. The present point of interest is that in methods and curriculum they were largely modeled on Columbia and Massachusetts Institute of Technology.

Within the last twenty years, a number of the schools have shown considerable independence in methods and curricula. It is, however, still a question if too many of our mining schools have not followed too closely the original models, rather than attempting courses, instruction, and development of a different character. The earlier mining engineering departments of the East developed at the time when the mineral deposits of the Rocky Mountain and Western states were first being developed, and before the mining schools of the West were well under way. As a result practically all graduates of the Eastern mining schools turned to the West as a field for their work. This Western movement continued until about 1900, when Western schools began to supply the technically trained men needed in their immediate mining industry.

The period from 1900 until the war (1914) can well be called a period of readjustment in the mining schools. Mining schools or departments which had been established in practically every state in which there was a mining industry now supplied a part of the demand for men formerly filled from more distant schools. These newer schools also began to send their men into foreign fields, previously supplied by graduates from Eastern schools. The older mining industry of the East began to absorb mining graduates, and men from Western schools began to enter mines east of the Mississippi. Today there are many graduates from Western mining schools who are employed by mining companies operating in the East. This period was also marked by a great number of our mining graduates going to foreign countries, particularly to Mexico, Canada, and South America. Today, the development of Canadian college mining departments is able to care for the demands in Canada of a rapidly increasing mining industry.

The war caused a great demand for minerals and a consequent demand for mining engineers to develop them. Post-war deflation in the mineral industry was of longer duration than in most other industries and resulted in many mining graduates being unable to find work in the field in which they had been trained. The effects of these periods of prosperity and depression are not noticed immediately in enrollment in a mining course. If there is a demand for men, the enrollment will increase until two or three years after the peak of the demand has passed. Likewise, if there is a depression in the industry, the student enrollment will decrease even for two or three years after the demand for men has returned to normal. Not for thirty years, however, have we had such small enrollments in the mining engi-

[1]The historical development of mining schools is taken largely from an article by W. E. Wickenden to be published shortly in the *Journal of Engineering Education.*

neering courses as at present. And this in the face of an unprecedented demand for our graduates. Most schools I have been in touch with report four or five jobs available for each graduate. Five years ago, there were probably more graduates than there were jobs.

Considerable has been written to the effect that in the future fewer mining engineers will be required owing to consolidations of great companies and to the disappearance of many small ones, and as a result of the lessened demand for the independent consulting mining expert or engineer. To grant that these two points are valid does not concede that there is a lessened demand for mining engineers. The change in conditions indicates, only, that the work open to the mining engineer has changed in character. Every other industry has enormously increased its rate of absorption of young engineering talent since the war. Every year, the representatives of various industries come to the colleges to interview men graduating in various branches of engineering. The mining industry, owing to its scattered nature, has done but little of this interviewing and selection of men at the colleges; consequently the conviction has gotten abroad among students that other branches of engineering offer greater opportunity than mining, whereas, for the individual man, probably at the present time the reverse is true.

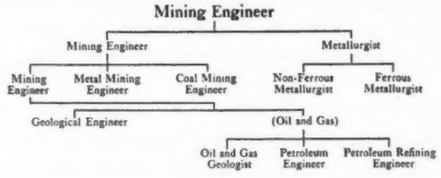
Another factor has affected mining enrollment: Thirty years ago mining engineering seemed the essence of romance to a host of adventurous young Americans. New mines were being opened in that country of romance, the great undeveloped West. Today the same adventurous youth is attracted by aviation. Mining has become more of an ordinary business in his point of view. Within the last four years there have been organized in a few American engineering schools courses in aeronautical engineering, and already more than 1,200 students are enrolled, with the number increasing each year. The most optimistic cannot now vision the place of all these specialists in the industry.

Thirty years ago, the term mining engineering covered the mineral industries, and the student was prepared so that he knew some geology, surveying, chemistry, metallurgy and something in mining engineering. Since that time the larger mining companies have perhaps increasingly taken men who are specialists in a particular field, as, for example, geologists for the geological work, chemists or metallurgists for their special work, and mining engineers chiefly for the operating or actual engineering work entailed in mining. The great growth that has taken place in the mining industry has been met by means of men with a specialized training, rather than by more men trained as mining engineers. Technical and scientific material available in the various branches of the mining industry has also increased so enormously that a mining school can no longer satisfy students or corporations by men prepared in one basic mining engineering course. The diagram following shows how, during the last twenty years, our mining schools have developed newer courses from the older general mining engineering course.

In addition there are border-line fields in ceramic engineering, chemical engineering, and others that give certain training closely allied with that of mining engineering.

Men long in the mining engineering profession may complain against this specialization in mining schools, but the answer is that today we have such an accumulation of knowledge in the various fields that the old basic mining engineering course will no longer prepare all men for the work they are interested in, and which employers insist that they shall have. For example, a petroleum company wishes a graduate with the oil and gas point of view; whereas a coal-mining company prefers a young engineer to have a coal-mining view point rather than some knowledge of copper mining or

Diagram showing development of new courses



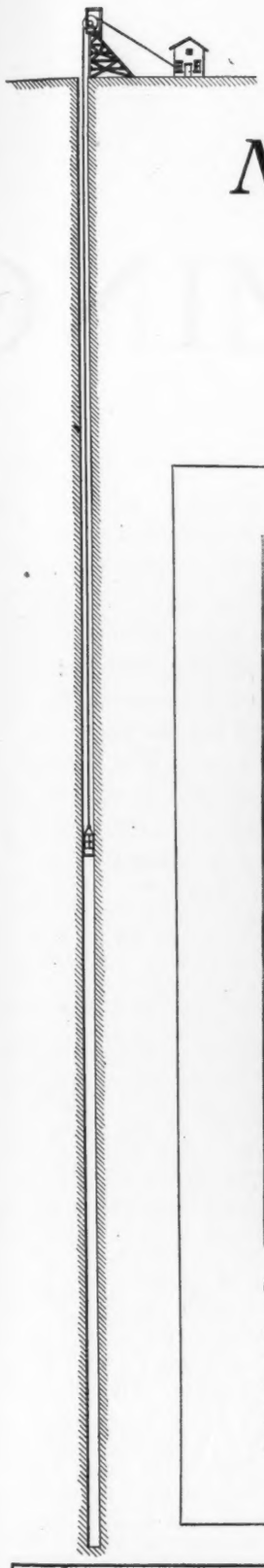
general metal mining. Young men in the schools themselves are very partial to the particular course they have chosen. The student metallurgist, for example, is not particularly interested in methods of mining; he feels that in his own selected branch there is enough of interest to absorb his professional interests. I feel that the answer of the mining school to the charge of specialization today must be: Put back the mining industry to where it was forty years ago and we can again offer one general course. Today, since we have only four years with a student, for two years we will give him a broad general background, and even for a third year; but the fourth year we must give him something of the point of view that he feels he came to school to obtain.

Thus, there have been factors which have decreased the enrollment in the mining engineering course—factors that have been created by specialization within the course itself, factors caused by the attitude of the employers, factors caused by an increase of other courses in mining schools, and factors caused by the increased demand for technically trained men in other industries. What of the future?

Mining is a basic industry and will continue so as long as civilization exists. There must always be a supply of trained men entering the industry, else the industry suffers and in turn every other industry is affected adversely. Mining is both an art and a science. The art of mining has been practiced for centuries. The science of mining is largely a creation of the last hundred years. Men trained in the science of mining have revolutionized mining practices in every branch of the industry that has freely received them. Witness the revolution that has taken place in copper-mining methods and practices in the last thirty years. Just now we are entering an equally important era in coal mining. There must be a continual supply of men trained in the science of mining if this progress is not to cease. Mining is an expanding industry. A simple survey of our statistics of production of any of the metals, or of the useful minerals, including coal, for the last thirty years, shows that production and consumption in every branch have increased tremendously, in some cases fivefold and tenfold. Surely this cannot mean fewer mines and less mining activity.

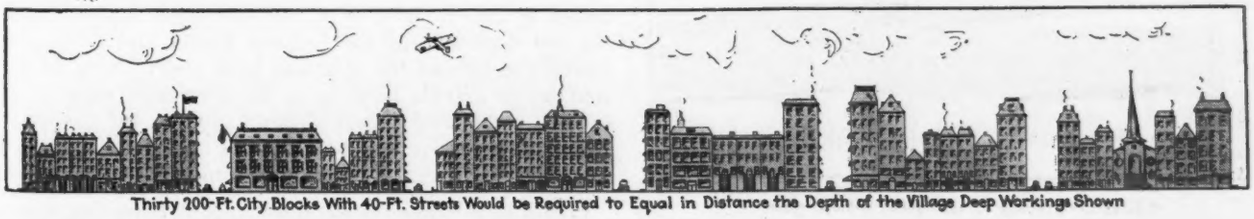
Mining requires constantly more skilled supervision. The slaves employed by the ancient Egyptions to mine, required little technical supervision. By comparison, our highly developed mines, with their problems of economical systems of mining, of ventilation, of trans-

(Continued on p. 797)



Nearly 1½ Miles Underground in an African Gold Mine

THIS remarkable picture was taken on the 38th level, west footwall drive, in the Village Deep mine of the great Witwatersrand gold region of South Africa, at a depth of 7,264 ft. (vertical) from the surface. This property holds the world's record for depth penetration into the earth, in the exploitation of ore. Directing ability of a high order, experienced supervision, and trained underground workers have contributed to the achievement, aided by the utilization of modern rock-drilling machinery. The units shown in the accompanying illustration of this mining operation are Ingersoll-Rand, Type 18A drifters.



Thirty 200-Ft. City Blocks With 40-Ft. Streets Would be Required to Equal in Distance the Depth of the Village Deep Workings Shown

AN *Example of*

MINING ZINC *an*

METHODS And COSTS

THIS PAPER is the second of a series of publications dealing with mining methods and costs in the metal mines of the United States, which are being written by officials and engineers of mining companies in accordance with an outline prepared by the U. S. Bureau of Mines, for the purpose of obtaining uniform and comparable data. The first paper, "Method and Costs of Mining Magnetite in the Mineville District, New York," was published in "Engineering and Mining Journal" of Feb. 19, 1929, pp. 234-237.

THE PURPOSE of this paper is to present to the operators in other districts a detailed description of the mining method used and the results obtained in exploiting one of the zinc-lead deposits of the Kansas-Oklahoma-Missouri district. No. 1 mine—the property described here—is situated in the heart of the town of Picher, in the extreme northeast corner of Oklahoma. Prospect drilling was first done at the mine late in 1914, and shaft sinking was started early in 1915. Sufficient ore was developed to start construction of the mill in April, 1916. Production began in August, 1916, and the mine has been producing, except for short periods, to the present time. The property was originally a 40-acre tract, but additional properties have been consolidated with the original one until the mine now covers 200 acres. The mill has a capacity of 1,400 tons in 24 hours and is one of the largest mills in the district. It was one of the first in the district to use flotation, a flotation plant having been added to the mill in the fall of 1917.

Surface rocks are of Pennsylvanian age, and are made up entirely of shales and sandstones of the Cherokee formation. The thickness of the Cherokee in the vicinity of No. 1 mine ranges from 60 to 100 ft. The Cherokee formation lies unconformably upon the limestones and sandstones of the Chester formation, the youngest member of Mississippian age. This formation, which is entirely absent in many places, has a maximum thickness of 40 ft. In churn-drill cuttings it is difficult to distinguish between the limestones of this formation and the underlying Boone formation, upon which it rests with a marked unconformity. The Boone formation is correlated with the Warwaw-Keokuk-Burlington series of other areas. It is the principal ore-bearing formation and consists of interbedded limestones and cherts. It is broken up locally into a number of members, the principal ones being the Short Creek oölite member, a thin but persistent oölitic limestone, and the Grand Falls chert member, a massive chert occurring 70 to 100 ft. below the base of the Short Creek oölite. The thickness of the Boone ranges from 275 to 325 ft.

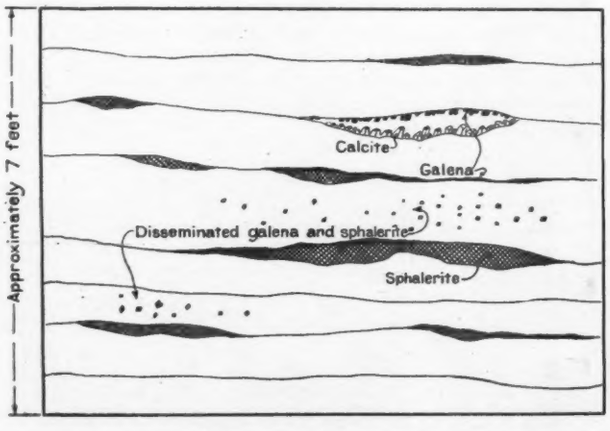


FIGURE 1.—Orebody of semi-sheet ground type

Ore deposits of No. 1 mine occur in the brecciated and boulder ground 35 ft. below the base of the Short Creek oölite. This horizon is at the 270-ft. or main mine level. Two minor ore horizons are mined, one at 230 ft., the Short Creek oölite horizon, and the other at 200 ft. The upper or 200-ft. level is of the semi-sheet ground type; the ore occurs along the bedding planes and is disseminated throughout the blue and gray chert. Ore on the middle, or 230-ft., level is of the brecciated type. Ore on the main level occurs disseminated in the jasperoid breccia, as massive lenses or patches and as the lining of vugs and cavities. The gangue minerals are jasperoid

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By W. F. NETZEBAND
Consulting Engineer, U. S. Bureau of Mines

C*and* LEAD ORE

At Picher, *Oklahoma*

breccia, chert, calcite, and dolomite. The accompanying sketches (Fig. 1 and 2) show the mode of occurrence of the ore in the different types of ground.

No surface indications of ore are found in the district. All exploration work is done with the churn drill and is usually started by drilling several rows of holes across the tract from north to south or east to west at intervals of 200 to 400 ft., until a favorable area has been defined, and then drilling the holes closer together. The earlier holes were drilled 5⅞ in. in diameter, but later the standard size was changed to 6¼ in. Logs of all holes are kept, and assays are made of all material running above 2 per cent blende or 1 per cent galena; mineralized production below this grade is recorded as "shines." On the 200 acres constituting the No. 1 mine property 128,204 ft. of drilling has been done. The drilling is all done on contract at prices ranging from $1 to $1.25 a foot, depending upon the character of the ground being drilled. Estimates of ore reserves are based on a careful analysis of the churn-drill records. Experience has shown that an orebody mills out about 10 per cent better than the estimate. In estimating tonnage, a factor of 12.5 cu.ft. per ton is used for rock in place.

Early mining methods were similar to the methods typical of the district: hand-shoveling into cans set on trucks, tramming by mule to the shaft, and hoisting the can of ore to the surface. When the original No. 1 mine was consolidated with the first of the other properties, mechanical haulage with cars instead of cans was installed. A skip hoist was installed at the mill shaft and all ore hauled thereto by trolley locomotive. Mechanical loaders of various types have been tried, but none has proved successful. Hand-loading has been found to be the most economical method.

As to the mining method, the open stope system with pillar support has continued to be used, as no other method has been found that could be employed satisfactorily in this type of ore deposit.

No definite development system is carried out once the shaft has been sunk to the ore and the mine opened up to the production stage. The churn drilling has defined the minable areas, and the problem has resolved itself into keeping the pillars in the leaner ore as much as possible and at the same time providing adequate support to the roof.

Prospect drifts, known locally as "pull" drifts, are driven ahead of the working as the occasion requires, but these are usually driven to an isolated, previously proved orebody, with the idea of later using them as haulage drifts.

Main Shaft—The main or mill shaft was originally sunk at the mill site on the original tract. The shaft is 5x7 ft. in cross-section, the standard size for shafts in the district. It is sunk to the 270 level, which is the main haulage level for the mine. Originally it was equipped with the usual type of Joplin hoist, using cans to bring the ore to the surface. The standard can holds about 1,400 lb. of ore.

The shaft is close-cribbed with 2x6-in. pine timbers from the collar of the shaft to a point below the shale. Careful lagging and packing behind the cribbing is necessary, as the shale slacks off and gives trouble when wet unless it is held securely in place so that it cannot slump. Below the shale no cribbing is necessary unless loose boulder ground is encountered, in which circumstance "jump" cribbing is tied in above and below to 6x6-in. bearing timbers set in hitches in solid rock. The shaft

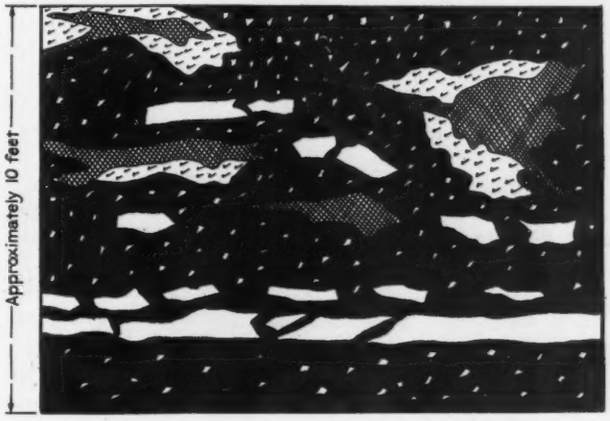


FIGURE 2.—Orebody of the brecciated type

was equipped for skips in 1920, using 2½-ton self-dumping skips and hoisting in balance.

Auxiliary Shafts—The usual practice in the district is to sink a shaft to an isolated orebody and tram the ore on the surface, rather than to connect underground and hoist at a central shaft. For this reason the mines usually have two or more "field" shafts for hoisting ore besides the mill shaft. At No. 1 mine, however, all ore is hoisted at the mill shaft. Before the various properties were consolidated, several shafts were sunk on each tract, so that at present there are fourteen "field" shafts on the 200 acres. The only one of these in use is equipped with a double-deck cage for men and material.

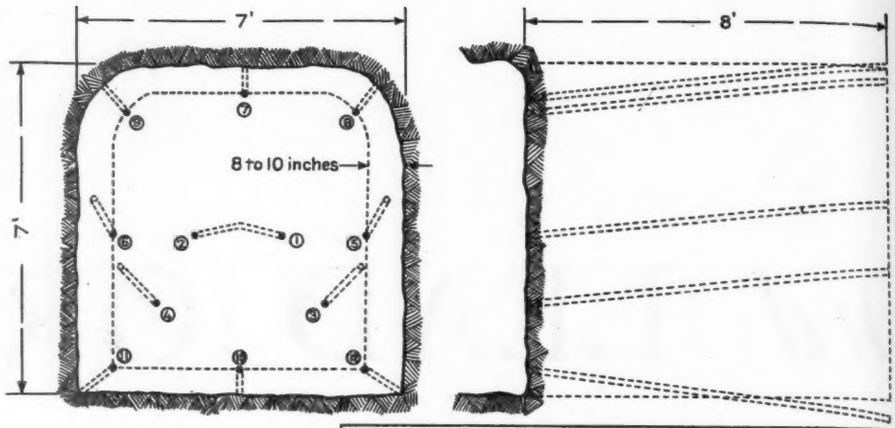


FIGURE 3.—Plan and profile of "pull drift" round

Order of firing "pull drift" round			
First	①②	6 ft. deep	20 to 30 sticks 35 % gelatin
Second	③④	8 " "	15 " 20 " " "
Third	⑥⑤	8 " "	10 " " "
Fourth	⑦ then ⑨⑧	8 " "	10 " " "
Fifth	⑬ then ⑪⑫	8 " "	12 to 15 " " "

The early shafts were sunk by the company as a regular part of the mining operation, and, because of the heavy flow of water, costs were excessive. The later shafts were sunk on contract, but as all of these were sunk a number of years ago, no costs are available. An average contract price is $12 per foot in shale and $18 per foot in the rock, the company furnishing everything but labor and powder.

Prospect or "Pull" Drifts—Prospect or "pull" drifts are driven 7x7 ft. in cross-section. The work is almost always done on contract, the contractor furnishing all the labor and the company all the equipment. Occasionally a contract is let by the terms of which the contractor furnishes everything but the track and piping.

The average round with the amounts of powder used is shown in the sketch (Fig. 3). Rounds are varied somewhat to meet the changing conditions of the ground. When the ground becomes harder, three or four cut holes are used, and occasionally it is found necessary to drill two or three extra bottom or "stope" holes to assure an even grade.

Powder used is 1¼x8 in. 33 per cent gelatin dynamite. The primers are made up with No. 6 caps; the caps are placed in the center of the stick of powder and the entire primer is put into safety tubes provided for the purpose.

Holes are drilled from a column set in the center of the drift; a heavy Leyner-type drill is used. All Leyner drills are operated by two men, a runner and a helper. The cut holes are drilled with 7-ft. steels to a depth of 6 ft., and all other holes are drilled with 9-ft. steels to a depth of 8 ft. Usually, 6 ft. are broken per round.

Costs given in the accompanying table are based on a drift which was contracted for at the rate of $7.50 per foot, with the contractor furnishing only the labor and the company furnishing everything else.

When a new orebody is being developed and the rock has to be hoisted to the surface, there is an additional cost of 14c. per foot for hoisting.

Raises—Raises are not often necessary, but when an isolated orebody is found above the main level a raise is driven up, usually at an angle of about 45 deg., so that it can later be used for an ore chute. The raises are driven 6x6 ft. in cross-section.

Raises are drilled from a shaft bar with the same type of heavy Leyner drill that is used in the "pull" drifts. The round used is practically the same as for the "pull" drift, except that the center stope and roof holes are not used. This practice cuts down the powder consumption slightly. The contract price is $3.50 per foot, but the contractor furnishes only the drilling labor. The company does the mucking and tramming and supplies all equipment. These costs will be practically the same for raises as for "pull" drifts.

After the upper orebody has been developed, to assure mining on that level, the raise is converted into an ore chute by putting a front on the lower end with a gate for loading. If the raise is the only means of entrance to the new ore level, a partition is built so that part can be used for a manway. Usually, however, two raises are driven, one to be used for a manway. This arrangement always affords better ventilation, and often a raise is driven solely for this purpose.

Formerly all raises were driven vertically with a light stoper, but the inclined raise has been found so satisfactory that no vertical raises are now driven.

Cost per Foot of Prospect Drift

	Cost	Per Cent
Drilling labor	$2.95	20.8
Mucking labor	4.42	31.3
Explosives	2.38	16.8
Tramming (power)	.97	6.9
Labor insurance carried by contractor	.48	3.4
Compressor	.62	4.4
Tracking and piping	.46	3.3
Ventilation	.43	3.0
Steel consumption	.06	0.4
Blacksmith	.70	5.0
Miscellaneous (carbide and repairs)	.66	4.7
Total cost per foot	$14.13	100.0

Present Mining Method

Plan and sections of No. 1 mine are shown in the sketches (Figs. 4 and 5). The headings are kept well in advance of the main stope except where the ore face is low, when no stope is carried, and the entire face is advanced by the same method as the heading. The chert and jasperoid breccia breaks into large boulders, and it is necessary to do a considerable amount of "boulder popping" before loading. All boulders are drilled with a light jackhammer before blasting. For all drilling except the "boulder popping," the heavy Leyner drill is used. The headings are drilled from a post, but the

stopes are drilled from a tripod. For ordinary work 33 per cent ammonia powder is used, but for wet work or where the ventilation is poor, gelatin powder of the same strength is used. The cost of ammonia powder averaged $0.1266 per pound and of gelatin powder $0.1400 per pound for 1928.

Underground Support—The mine is supported almost entirely by pillars of ore from 20 to 60 ft. in diameter, the average being 30 ft. Their size depends upon the character of the ground and the height of roof. Pillars are spaced 40 to 100 ft., center to center, with an average spacing of 80 ft. Wherever the character of the ground permits, the roof is arched between pillars. Some of the pillars have been trimmed down as small as was considered safe; these have shown no signs of taking weight. At present the pillars represent about 15 per cent of the total area cut, but many of these will be recovered before the mine is abandoned. All pillars cannot be recovered, for the mine is under the town of Picher and the surface must be protected.

There are parts of the mine where thick shale or loose boulder ground necessitates timbering, but generally these parts are not ore-bearing and only "pull" drifts are driven through them. This method of support is of minor importance in the mining operations.

Drilling and Blasting Practice

Compressors—Air is furnished from a central compressor plant serving several mines. The capacity of this plant is 9,380 cu.ft. per minute. Individual compressors range in capacity from 1,080 to 4,700 cu.ft. The air is maintained at 110 lb. at the plant.

No. 1 mine consumes about 1,600 cu.ft. of air per minute. The pressure at the machines ranges from 85 to 90 lb., the average being about 86 lb.

Drills—The drills used are all of the heavy Leyner type, although several makes of machines are used. They are run from tripods or columns. All drills use 1¼-in. hollow-round steel. Jackhammers are employed for "boulder popping," using 1-in. hexagon, hollow steel.

The standard cross bit with 18-deg. taper and ¼-in. difference in gage is used for both the Leyner drills and the jackhammers. Steel lengths for the Leyner drills are 5, 7, 9, 11, 13, 15, 17, and 20 ft. Holes are started with 2¾-in. gage and the 20-ft. holes bottomed with 1½-in. gage. The jackhammer steels are made up into 1-, 3-, and 5-ft. lengths. Holes are started with 2-in. gage and the 5-ft. holes are bottomed with 1½-in. gage. The steels are bitted and shanked underground at a central plant near the material shaft. The steel consumption is 0.073 lb. per ton of ore mined.

Blasting—Blasting practice in the district is different from that at most metal mines; so the practice will be described in some detail. The heading rounds are loaded with three-fourths of a box of ammonia powder, twelve to fourteen sticks to the hole. When the ground is hard and tight, and a six-hole round is used, the holes are fired in the order shown in the diagram (Fig. 6). In ordinary ground, No. 1 hole is omitted and No. 2 hole is placed vertically above No. 3. In this arrangement No. 2 is the lead hole and the other holes are fired in the same sequence as before. Where the face is less than 12 ft. high, only a heading round is used. All holes are stemmed, using a clay cartridge prepared for the purpose.

For mine faces ranging from 25 to 40 ft. high, the round shown in the diagram is used. For mine faces above 40 ft. two sets of splitters are used, making six splitters and three stope holes. The slope of the stope is kept at an angle of about 45. deg. For the 40-ft. face, which will be taken as a model in the following description, the collars of the splitter holes are about 20 ft. horizontally behind the heading round, and likewise the collars of the stope holes are about 20 ft. behind the collars of the splitters. Where the mine faces are lower, the measurements are cut down accordingly. For faces over 40 ft. high, six splitter holes, in two rows of three each, and three stope holes are used. In every case the burden is the same on each hole.

The splitter holes are three in number, one in the center and one on either side, all in the same horizontal plane. These holes are drilled with a rise of 1 in. to the foot, so that they can be readily washed of all cuttings after squibbing. The holes are drilled with 20-ft. steels. Stope holes are also three in number and are placed vertically under the splitters. These holes are drilled down with the same fall that the splitters have

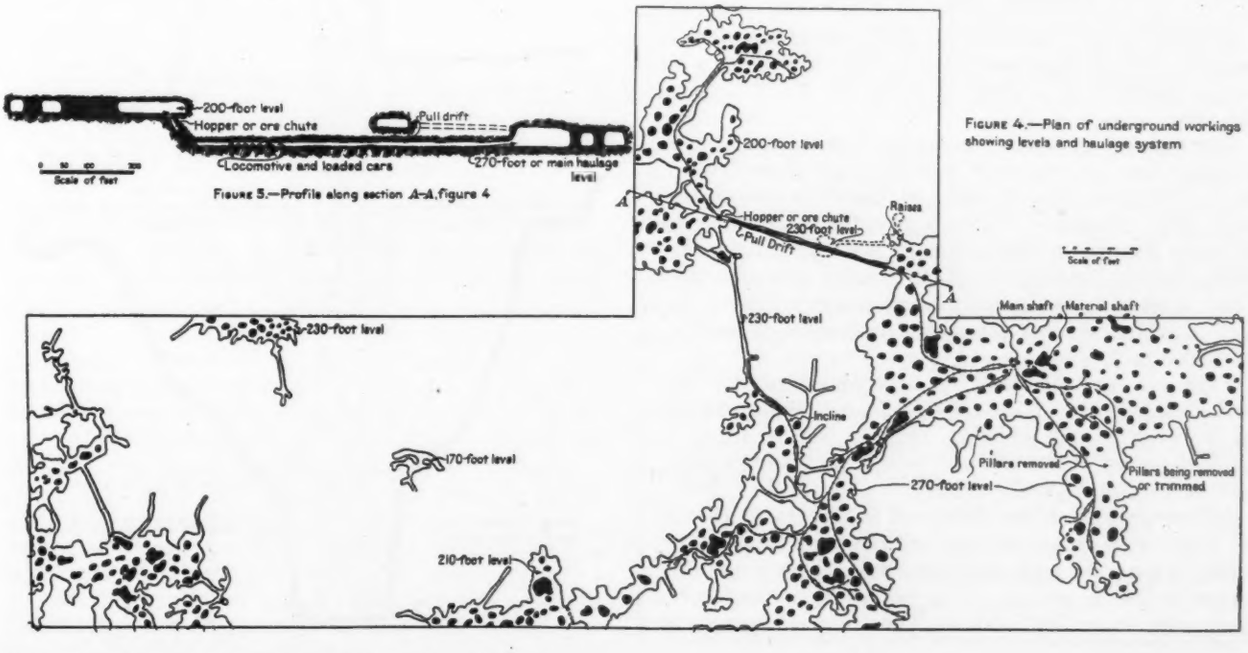


Figure 5.—Profile along section A-A, figure 4

Figure 4.—Plan of underground workings showing levels and haulage system

rise. They are so located that the bottom of the hole will be below the grade of the drift so as to prevent high bottom.

Each splitter and stope hole is squibbed or chambered three times before the final charge is loaded. The first time fifteen sticks of powder are used. The hole is then thoroughly washed, and 24 hours later is shot with 30 sticks of powder. After again being thoroughly washed, the hole is loaded with from 45 sticks to one box of powder, depending on the size of the pocket. The hole is once more thoroughly washed, preparatory to loading the breaking charge. For this charge from two to four boxes of powder are used. The hole is very seldom loaded to the collar except where the ground at the collar is unusually tight, because of soft or cavey ground between the collar and the pocket. All holes are stemmed, using a clay cartridge prepared from clay found on one of the company's properties. The cartridges cost about $0.01 each. An average stope or splitter hole will break about 250 tons of ore. Powder consumption is 0.75 pounds per ton. A heading round will break 40 tons per machine shift, and where stope and splitter holes are used, 60 tons per machine shift are broken. For high headings (70 ft.) 75 tons per machine shift has been broken.

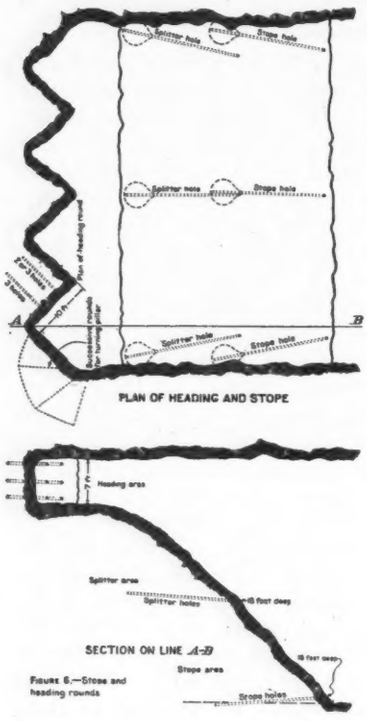


Figure 6.—Stope and heading rounds

Loading and Tramming

All loading is by hand labor. The cars are of 20-cu.ft. capacity and average one ton of ore. The size of the car is 4x2½x2 ft. Track gage is 24 in. throughout the mine.

The cars are gathered on "lay-bys" or sidings near the working face by trammers who help the shovelers with the loaded cars. One trammer or "mule" is provided for every four shovelers. For short hauls mules are used to bring the cars to the shaft or hopper, but for long hauls electric locomotives of the trolley type are used. Three mules are used underground and two locomotives, each of which weighs 4½ tons and is capable of handling 40 loaded cars.

Trammers or "bumpers" take the cars from the "lay-bys" near the skip pocket (Fig. 7) and dump the ore upon a grizzly made of 90-lb. rails set 6 in. apart above the skip pocket. "Screen apes" sledge all boulders which will not pass through the grizzly.

All ore mined on the 200 level in the north part of the mine is dumped into an ore chute or hopper and drawn out on the main haulage level. This is the only hopper in use at present. The hopper is a raise driven at an angle of 45 deg. with the lower end equipped with gates for drawing off the ore. The gates are raised and lowered by a simple lever arrangement.

The only pumping necessary is from a sump which drains the skip pocket. The water level has been lowered for the district so that the main level is dry. To keep the sump dry, two small pumps with a combined capacity of 100 g.p.m. are run for about three hours each day.

Record of Labor Performed at Mine No. 1
July to December, 1928

	Total Shifts for Six Months	Tons per Shift
Trammers	2,125	32.36
Drill runners and helpers	3,000	22.92
Muckers	3,500	19.65
Miscellaneous	3,000	22.92
Total underground operations	11,625	5.91

Ore hoisted during last six months of 1928 amounted to 68,770 tons.

Percentage of Extraction

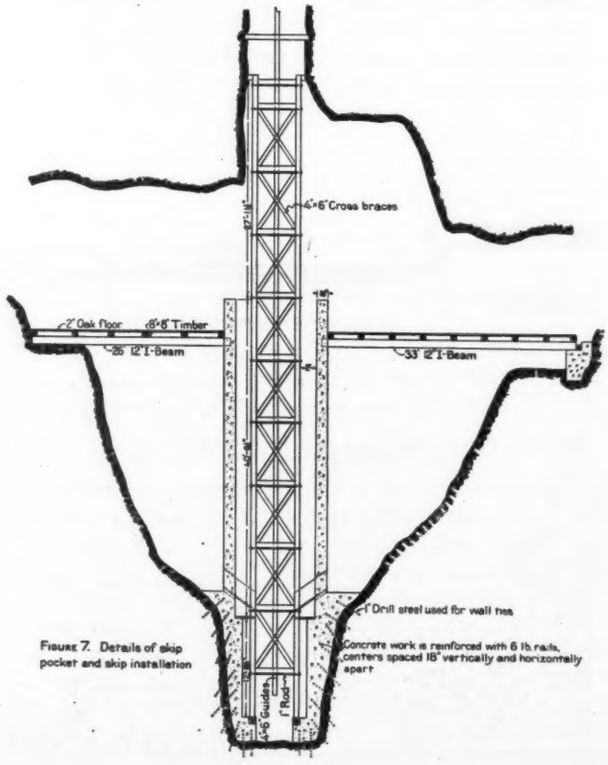
At present, 15 per cent of the area mined is left in pillars, but the operators believe that after the mine is abandoned 90 per cent of the ore, at least, will have been extracted and that most of the remaining 10 per cent will be in lean ore and will not represent a great loss.

Wage and Contract System

All labor except mucking is based on an eight-hour day. Muckers are paid on contract, 14½c. per car if they work less than six shifts per week, and 15½c. per car if they work the full six shifts. When loading from a large pile, with little clean-up work, the average mucker will load 30 to 40 tons per shift.

The following wage schedule was in effect for 1928 when zinc concentrate prices stayed at $40 or under for the year:

Machine runners	$4.25	Locomotive operators	$4.25
Machine helpers	3.75	Locomotive brakemen	3.75
Trammers	3.50	Powdermen	4.50
Blacksmiths	4.25	Roof trimmers	4.00
Hoistmen	4.75	Screenmen	3.50


4"x6" Cross braces
2" Oak floor
8"x8" Timber
26' 12"I-Beam
33' 12"I-Beam
1" Drill steel used for wall ties
Concrete work is reinforced with 6 lb. rails, centers spaced 18" vertically and horizontally apart
6"x6" Guides
1" Rod
Figure 7. Details of skip pocket and skip installation

This wage scale is based on $40 zinc concentrate. If the price goes above $45 and stays there for one week, all wages are automatically raised 25c. per shift and muckers are raised half a cent on the car. Likewise, for every $5 rise in the price above $45 the wages are raised at the same rate, but for every drop of $5 the wages are reduced accordingly. A week is always allowed between the wage changes, to make sure that the market will not fluctuate above or below the critical price.

Ventilation is natural except in rare instances where a long drift is being driven or an orebody opened up from a raise. Under such conditions ventilation is supplied by small blowers driven by motors. Where the drift or orebody cuts a churn-drill hole, this hole is cleaned out and the blower installed on the surface. If no drill hole is available, canvas tubing is used and the blower set out in the main workings.

So little timber is used underground that the fire hazard is practically nil. In the event of fire at the surface buildings, the workings are cut into other properties, so that the men are never in danger.

Below is the total cost for delivering a ton of ore to the surface at No. 1 mine:

Cost of Delivering One Ton of Ore to the Surface at No. 1 Mine

	Cost	Per Cent
Total underground labor	$0.598	60.7
Supervision	.026	2.6
Compressors, air drills, drill steel	.127	12.9
Electric power	.041	4.2
Explosives	.110	11.2
Other supplies	.083	8.4
Total cost	$0.985	100.0

Summary of Costs in Units of Labor, Power and Supplies, July to December, 1928

	Year, 1928 Six Months' Operation	
Name or number of mine—No. 1		
Tons of ore mined and hoisted: 68,770		
Mining method: Open stopes with pillar support		
(A) Labor (man-hours per ton):	Cost	Per Cent
Breaking (drilling and blasting)	0.377	28.1
Mucking	0.407	30.4
Haulage and hoisting	0.282	21.0
Supervision	0.028	2.1
General	0.247	18.4
Total labor underground	$1.341	100.0
Average tons per man per shift	5.91	
Labor, percentage of total cost	63.35	
(B) Power and supplies:		
Explosives (pounds per ton)—33 per cent ammonia and gelatin	$0.750	
Total power (horsepower-hours per ton)	9.91	
(1) Air compression	6.00	
(2) Hoisting	2.77	
(3) Pumping	0.22	
(4) Haulage (includes lighting)	0.92	
Other supplies in percentage of total supplies and power	22.99	
Supplies and power, percentage of total cost	36.65	

Much attention has been given to safety in the last few years. The company maintains a full-time safety engineer and assistant. These men have full power to enforce any safety measures they may deem necessary. The Tri-State Zinc and Lead Ore Producers' Association also maintains a full-time safety engineer to co-operate with and co-ordinate the work of the various company men. A system of presenting flags to the various mines for not losing any time from accidents for periods of three, six, and twelve months has been initiated by the association. This has aroused the men's interest in safety measures, as is shown by the fact that mines from this district won the *Explosive Engineer's* Safety Trophy for the years 1926 and 1927 and that several mines from the district were in the runner-up list for 1928. The company further arouses the interest of the men by paying all ground bosses a bonus of $25 for every month passed without a lost-time accident, and the men are given a pair of cotton work gloves.

Is There a Serious Shortage of Mining Engineering Students?

(Continued from page 790)

portation, of safety, and of exploitation, require a high type of supervision, and, with every decrease in the amount of manual labor used, and with every innovation for economy, will continually require more and more skilled supervision. The coal industry alone is in a period of transition between manual art and mechanical methods where it should be absorbing alone practically the whole output of our mining engineering courses today.

Mining is a vast industry. In mining we have an industry extending practically to every state. In Pennsylvania alone more than two million people are dependent on it for their support. Without going into a comparison as to the amount of gold, silver, copper, zinc, lead, coal, and other minerals produced in this country, it is sufficient to say that more than 50 per cent of the total freight hauled by the railroads of the United States is composed of the direct products of the mine. And in the less than 50 per cent are included all farm and food products, lumber, manufactured goods of all description, and all other freight. Have we in mining a minor or a dying industry?

Making allowances for all the sons and daughters of the old mining engineering course which have adopted new names and taken an increasing number of young technical men, the fact remains that we must have an increasing supply of men training in mining engineering, who expect to follow mining itself; otherwise the mining companies will within five or ten years be sufferers. Two hundred graduates per year, after allowing for those who take mining because it is a broad general training and for those who go outside the country, are not enough to keep our mineral resources in a healthy condition. They are not enough to supply a single branch of industry. I know of no field of engineering with a more promising outlook during the next few years and for a lifetime for men with the necessary qualifications.

For self-protection, the large mining corporations should realize that under present industrial conditions the electrical, the steel, and other great industries are seeking, taking, and training the young engineering graduate in rapidly increasing numbers, and the necessity of inducing more and better young men to enter the mining field demands an increasingly interest in the young mining graduate on the part of the mining company.

SOME OF THE DIFFICULTIES of driving an 18,000-ft. tunnel through medium ground as contrasted with hard rock will be described by George J. Young, in an article on the Claremont Tunnel, in the next issue.

What Kept Copper Prices

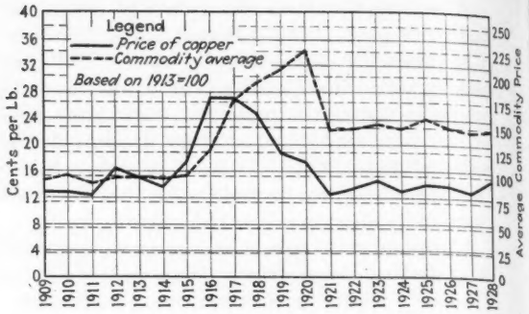


Fig. 1—Comparison of the price of copper and the general commodity level since 1909

IN THE last six months, the upward trend of the copper market has attracted widespread attention. During this period the price of the commodity has fluctuated widely after seven years of comparative stability. Under these conditions, talk of a "copper trust" and of various producers' agreements has been disseminated by sundry "experts" who desire to protect an unsuspecting public from the sinister wiles of the copper "kings." On the other hand, producers claim—and not without justice—that copper has been selling far below its pre-war value in terms of the post-war dollar and that the rise in price has merely been a return to a long-delayed normal. The truth, of course, lies somewhere between these extremes, and probably was most closely approached in the article by A. B. Parsons on "What Will Copper Do?" that appeared in the April 6 issue. Mr. Parsons claimed that copper, like every other commodity not subject to a monopoly, would eventually succumb to economic law and that the price of copper must eventually be stabilized at the cost of production of the marginal producer, despite all moral or ethical claims for higher or lower prices advanced by interested persons.

If Mr. Parsons' contention is correct, the long-existent phenomenon of pre-war prices for copper in a post-war market merits considerable attention, because it necessarily means that producers have been operating at pre-war costs as well. Consider the price fluctuations of cheese and copper, and the impressiveness of such an achievement becomes more marked.

In 1913, whole-milk cheese was selling on the wholesale markets in New York at about the same price as electrolytic copper—15c. a pound. In the economic readjustment that occurred during and after the World War, commodity prices were shuffled about unceremoniously. Once the depression of 1921 had been passed, however, some degree of stability was attained. Since that time cheese has consistently sold between 21 and 25c. a pound, but copper, until last October, ranged from 13c. to 15c. Under fairly normal conditions then, copper sold at the same level as cheese before the war, but for less than two-thirds as much after.

Now, the statement can safely be made, I believe, that cheese is an inexhaustible commodity. As long as we have cows we can be fairly certain that we will have cheese. Moreover, no sudden increase in the demands of cheese lovers has been apparent in the last fifteen or twenty years. Consumption has increased in direct proportion to the increase in population, and the price has increased in direct proportion to the cost of production. From an economist's point of view, then, cheese is a model commodity.

Copper differs from cheese in a great many ways, in addition to its absolute dissimilarity in appearance and taste. Copper, unlike cheese, is not inexhaustible. A copper famine may not be immediately imminent, but eventually it may come. Copper, also, unlike cheese, is much more in demand, and world production is almost twice as great today as it was in 1913. Since the war only two important new sources of copper have been put into production—Andes and Noranda—although at present several other new mines are "in the making." And, finally, the cost of living has increased as markedly in the copper camps as it has in the dairy districts. Equipment and labor is on a post-war, not a pre-war, basis. Fig. 1, which compares copper prices and commodity prices since 1909, shows this clearly. To equal the commodity average, copper must sell at 22c.

But in spite of these unfavorable factors, the cost of producing copper has been reduced, for, if we are to accept the theory of the marginal producer, most of the copper sold was sold at a profit. And yet, examination of the dividend tables for any one of the years between 1921 and 1928 shows that the number of companies paying dividends among the copper producers is markedly small. What has happened to the profits?

An answer to this enigma—most of the copper apparently being produced at a profit but most of the copper companies not paying dividends—must exist, if for no other reason than that without one our economists would be much perturbed. The answer, if figures mean anything (though it is sometimes doubtful if they do), is that a combination of technical knowledge and large-scale production has enabled a few companies to produce most of the copper, and at a profit.

Readers of *Engineering and Mining Journal* hardly need to have the progress of technical knowledge in the last two decades described to them. These pages have been filled with an account of that progress week by week. Flotation and improved mining methods have enabled the profitable production of copper from deposits

By S. D. Strauss
Editorial Staff

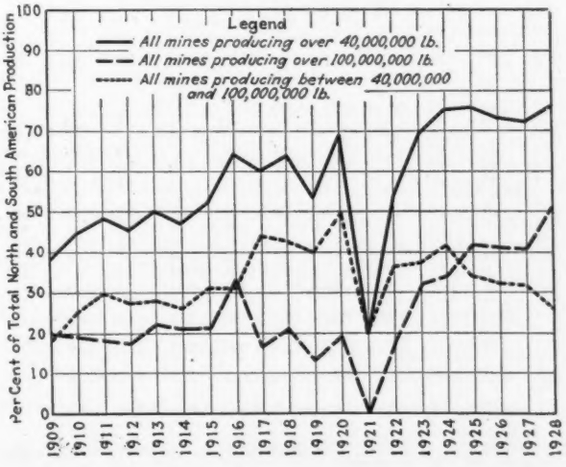
Study of Production Trends in the Last Twenty Years Offers an Explanation of the Stabilization of Prices at a Pre-War Level in a Post-War Market From 1921 to 1928

es Down?

that were once considered worthless. But the rôle that has been played by large-scale production in keeping the price of the metal down to pre-war levels has not been pointed out so frequently. If anything, the man in the street deplores the coming of the large corporation. He prefers the more picturesque and more inefficient small company, and when he sees about him the unmistakable signs of its decay—if not its demise—he bewails its passing, which he ascribes to the voraciousness of the large producer rather than to economic trends.

This article purports to show that the growth of large-scale operations in North and South America during the last twenty years has enabled the price of copper to remain comparatively stable in a general price structure that was moving upward. Before such a study can be made, however, "large-scale operation" must be more clearly defined. For the purposes of this article, and with no desire to set a standard, 40,000,000 lb. of copper a year has been arbitrarily designated as the production that distinguishes a large operation from a small one. This figure has no particular merit except that it represents at least 1 per cent of the entire world production in any single year within the period under consideration, and that, with one exception, every mine now producing 40,000,000 lb. of copper a year is also extracting more than 1,000 tons of ore daily, in itself an indication of large operation.

Fig. 2—How the percentage of total copper production in North and South America contributed by the large-scale mines has increased since 1909



The word "operation" is taken here to mean contiguous group operation by a single company. Thus, the Anaconda properties at Butte, although they number more than a score of mines, are really a single operation and obtain all the benefits of such. On the other hand, the three properties of Nevada Consolidated or of Phelps Dodge, situated in widely separated districts, are certainly separate and are considered separately.

Fig. 2 shows how the proportion of the total production of North and South America for which the large-scale operations are responsible has increased since 1909. In that year, all the mines producing more than 40,000,000 lb. of copper a year contributed only 38 per cent of the total. Since then, their percentage has risen, until, in 1928, it was about 75 per cent, or double the 1909 percentage.

As Fig. 3 indicates, however, the actual increase in production was much greater. Five mines each produced more than 40,000,000 lb. in 1909, and their combined output was 538,000,000 lb., out of a total of 1,424,000,000 lb. Anaconda alone, with its production of 292,000,000 lb., accounted for more than half of the output of the large-scale mines. In 1928, the number of mines in the large-scale classification was 21, and their output was about 2,296,000,000 lb., of a total of 3,074,000,000 lb. Large-scale operations, then, produced more than four times as much copper in 1928 as in 1909, although the total production had only doubled. Of the 21 large-scale mines in 1928, it is interesting to note that eleven had not started to produce in 1909, that six had started but had not yet attained large-scale proportions, and that four of the original five were still in that classification.

In Table I is listed every operation in North or South America that has produced more than 40,000,000 lb. in any single year since 1909. The figures used for Calumet & Hecla show only production from the Calumet & Hecla mine until 1923, when consolidation with several subsidiaries in the Michigan copper district was completed. Thereafter the production of these subsidiaries is included, as the merger was undertaken for the specific purpose of effecting economies that could be obtained through joint operation. Granby Consolidated

and Old Dominion have both been credited with production of more than 40,000,000 lb. during the period under consideration. Granby is not included in the table, however, because its output has come from three separate operations—Anyox, Allenby, and Boundary, the last named now inactive. At no time has any one of these mines produced the requisite amount. Old Dominion is excluded because custom ore was included in its production figures during the period that the Old Dominion smelter was in operation.

That a good mine, like an old soldier, hardly ever dies but merely fades away, and that the managements of most large copper-mining companies act carefully before installing equipment, is indicated by the fact that only three operations listed in the table failed to produce more than 40,000,000 lb. in 1928. Champion, in the Michigan district, qualified for the select group in only one year—1916—when prices went sky high and nearly all copper mines were taxed to their productive limit. This property, however, is still producing regularly. Greene Cananea, which was one of the five original large-scale producers, and which has been in operation since 1906, has not produced more than 40,000,000 lb. since 1923. In 1928, however, production showed an increase of 8,000,000 lb., and with ore available from the new discoveries in the Colorada mine, this company will undoubtedly resume its place in the list. Kennecott, in Alaska, is gradually exhausting its bonanza ore, and production has been declining for several years. Since Kennecott carries high-grade ore and since, therefore, the investment in plant was not so great, comparatively, as in the lower-grade mines, the more rapid depletion of its ore reserve is justified. The only other name on the list that is likely to disappear within the next few years is that of United Verde Extension, operating in the Jerome district, which has ore reserves for only three more years of operation indicated, and little chance of finding more.

If there are not likely to be many subtractions from the list, neither are there likely to be many additions, besides Greene Cananea. Noranda, which produced about 34,000,000 lb. in 1928, the first complete year of operation, will almost certainly be included in 1929. Magma, at Superior, Ariz., has also been increasing its output and is now producing about 3,400,000 lb. a month, or enough to warrant its inclusion. Minas de Matahambre, the American Metal subsidiary in Cuba; the Anyox operation of Granby Consolidated, which will soon be extracting ore from the Bonanza mine; Consolidated Coppermines, in the Ely district; and Flin Flon and Sherritt-Gordon, in Manitoba, are all possibilities.

Outside the area considered in this article, only three large-scale operations are now in existence—Union Minière, Rio Tinto, and Mansfeld. However, the development of the Rhodesian mines will add to this list, and the Mines de Bor, in Serbia, which has reached an annual production of 30,000,000 lb., may eventually attain 40,000,000 lb.

If a further classification is attempted, and only those properties producing more than 100,000,000 lb. of copper a year are considered, the results are equally interesting. Anaconda, the only operation to surpass this figure in 1909, alone produced about 20 per cent of the total. Until 1912, the Butte mines remained unique in this classification, but in that year Utah Copper also produced more than 100,000,000 lb. Although several other mines were able to equal this figure at one time or other during the war, not until 1923 did the contribution of mines in this classification become of real importance. Last year, the eight mines that produced more than 100,000,000 lb. accounted for a total of 1,555,000,000 lb., or more than five times the amount that Anaconda put out in 1909.

Thus the period under consideration may itself be divided into two parts. In the first part, from 1909 to 1923, increase in production came from mines producing between 40,000,000 and 100,000,000 lb. and in the second part, 1923-1928, the increase came from mines producing more than 100,000,000 lb., as shown in Fig. 2. As four mines on the American continents—Utah, Chile, Anaconda, and Braden—are now producing more than 200,000,000 lb. annually, and at least one other mine,

Table I—Large-Scale Production in North and South America During the Last Twenty Years (*a*)

Figures in Millions of Pounds—Production Not Shown When Less Than 40,000,000, Lb. a Year

	1909	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	
Anaconda	292	267	254	295	231	198	232	307	225	254	114	128	....	138	190	221	236	229	204	228	(c
Andes	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	54	104	
Braden Copper	....	....	....	....	....	....	....	42	64	77	42	65	....	93	138	157	154	181	203	218	
Calumet & Arizona	....	....	50	53	53	53	65	75	59	51	45	42	....	....	42	42	45	47	48	52	
Calumet & Hecla	74	73	74	68	45	54	72	77	78	68	53	43	....	41	63	73	91	104	109	121	
Cerro de Pasco	....	40	48	45	44	41	61	71	73	72	58	52	56	64	92	72	79	92	90	98	
Champion	....	....	....	....	....	....	....	55	....	....	....	....	....	....	....	....	....	....	....	....	
Chile	....	....	....	....	....	....	....	41	88	102	77	111	54	134	205	212	220	220	220	266	
Greene Cananea	44	46	45	48	45	....	....	49	....	53	41	44	....	....	42	....	....	....	....	....	
Howe Sound	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	42	
Inspiration	....	....	....	....	....	....	....	120	81	98	78	79	....	70	89	91	82	82	88	88	
International Nickel	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	45	(c)
Kennecott	....	....	....	....	....	....	....	108	78	61	....	53	....	44	50	41	43	....	....	....	
Miami	....	....	....	....	....	....	42	54	44	58	54	56	53	67	65	60	52	55	53	48	
New Cornelia	....	....	....	....	....	....	....	....	....	47	....	40	....	....	....	64	69	82	73	78	
Nevada Con.—Chino	....	....	....	....	51	54	65	72	80	76	41	44	....	....	54	67	67	74	65	80	(d)
Nevada	....	62	63	63	65	49	63	91	82	77	44	48	....	....	61	70	74	90	89	118	(d)
Ray	....	....	....	....	52	57	60	75	89	84	46	47	....	....	61	67	75	67	65	70	(d)
Phelps Dodge—																					
Copper Queen	76	76	74	88	97	86	89	103	94	91	69	71	....	48	76	92	101	95	89	108	
Moctezuma	....	....	....	....	....	....	....	....	....	43	....	....	....	....	....	40	44	....	....	41	(c)
Morenci (*b*)	....	....	....	....	....	....	....	42	40	....	....	....	....	....	....	41	59	65	59	54	
United Verde	....	....	....	....	....	....	45	58	72	78	42	65	....	41	98	98	108	107	100	118	(c)
United Verde Extension	....	....	....	....	....	....	....	63	56	....	....	42	....	....	42	44	44	43	41	45	
Utah	52	85	94	91	113	115	148	188	196	188	105	102	....	85	195	215	214	234	233	274	
Total all large mines	538	649	702	751	796	707	942	1,587	1,508	1,674	909	1,132	163	825	1,563	1,767	1,857	1,867	1,883	2,296	
Total all mines producing over 100,000,000	292	267	254	295	344	313	380	827	421	544	219	341	....	272	728	805	1,033	1,075	1,069	1,555	
Total all small mines	886	798	729	899	795	786	878	865	996	921	814	644	630	721	695	622	631	723	760	778	
Total all mines (*a*)	1,424	1,447	1,431	1,650	1,591	1,493	1,820	2,452	2,504	2,595	1,723	1,766	793	1,546	2,258	2,389	2,488	2,590	2,643	3,074	

(*a*) Totals for all mines from A.B.M.S. figures of blister production. Company figures are either blister or refined, as shown in company report.
(*b*) Morenci figures include Arizona Copper figures in 1917, 1918.
(*c*) Estimated.
(*d*) Nevada Con. total for 1928—268,000,000 lb.—is correct but output of individual branches is estimated.

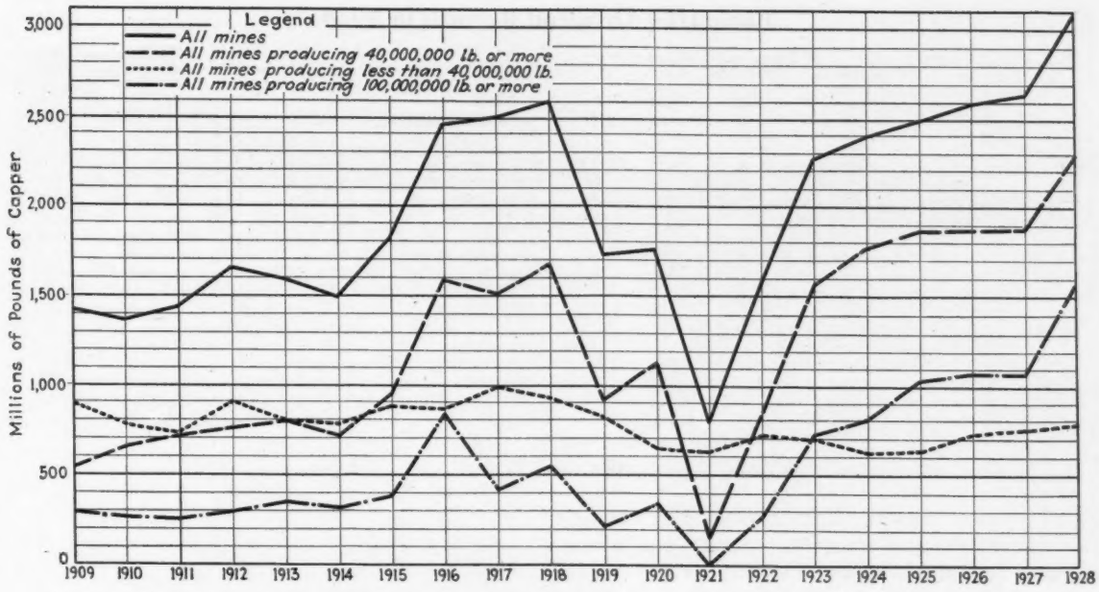


Fig. 3—The increase in the production of the large-scale mines is shown here in actual output, rather than in percentage. Note that the small-scale mines have contributed practically the same amount every year since 1909.

Andes, should reach that mark soon, the statement is justified that the trend toward increasing the scale of operations has not yet been stopped.

We must not forget the small mine while statistically dissecting the achievement of the large. What about its production? Fig. 3 shows perhaps the most interesting point of all: that the small mines, in the last twenty years, have produced practically the same amount every year. The general theory is that the small mines open or close as the price goes up or down. That this is only partly true can easily be seen. In 1909 the small mines produced 886,000,000 lb. of copper and in 1928 they produced 778,000,000 lb. The 1928 figure showed an increase of 123,000,000 lb. over 1927, if the new "large-scale" operations are deducted, of which one-quarter came from the increase at Noranda. Table II shows how the total increase of 431,000,000 lb. in 1928 over 1927 was divided among the large and small-scale operations. Notice that 21 large-scale operations increased production about 310,000,000 lb. in a single year, although they operated at capacity only during the last three months. To state that the large producers have been trying to restrict output, in the face of such facts, is absurd.

In 1918 the copper-mining industry in North and South America, operating at capacity under the pressure of the tremendous demand for copper for the war, produced 500,000,0000 lb. less than in 1928. In the interval between these years only two mines, producing 138,000,000 lb. of copper in 1928, were added to the list; but to more than offset this gain the production of small-scale operations was reduced by 200,000,000 lb. In other words, the large-scale mines that operated both in 1918 and 1928 increased capacity more than 550,000,000 lb. during a period in which the price of copper averaged 14.5c. a pound.

What has happened during the last six months is simply that the increase in consumption, real or apparent, has temporarily outstripped existing idle productive capacity. In view of the expensiveness of idle machinery, the copper producers can hardly be blamed for not maintaining more excess capacity.

The figures presented so far have undoubtedly proved that more of our copper is coming from large-scale operations today than came twenty years ago. But this does not necessarily mean that the large-scale operation is the factor responsible for pre-war prices in a post-war market, the reader may argue. Possibly the copper deposits found and exploited during the last twenty years may have been larger than the copper deposits found in other years. Technical efficiency may be the deciding factor alone, whether applied to large mines or small.

Table II—How the Increase in Production in 1928 Was Effected

All Figures in Millions of Pounds

	1927	1928	Increase
1. New Operations—			
Noranda	2	34	32
2. Small Operations	652	743	91
3. New Large Operations—			
Howe Sound	34	42	8
International Nickel	36(e)	45(e)	9
Moctezuma	36(e)	42(e)	6
4. Operations Producing Between 40,000,000 and 100,000,000 lb.	582	613	31
5. New 100,000,000-lb. Operations			
Andes	54	104	50
Copper Queen	89	108	19
Nevada	89	118	29
6. Established 100,000,000-lb. Operations	1,069	1,225	156
Totals	2,643	3,074	431

(e) Estimated.

Table III should settle the question. In it are shown dividend records of 39 companies engaged in the business of copper mining during 1928. Of these 39, fifteen are listed under the heading "Large Scale" and account for 19 of the 21 such operations in Table I. Three companies are listed under "Miscellaneous" for obvious reasons. They account for two large and two small operations. Under "Small Scale" are listed the remaining 21 companies.

During 1928, the average price of copper was 14.57c. per pound, a figure that closely approaches the general average of 14.50c. per pound for the entire post-war period. For the copper industry as a whole, it was generally conceded to be a prosperous year, and therefore the dividend records should tell fairly accurately

Table III—Dividend Records in 1928

Name	"Large Scale" Mines: Output In Millions of Pounds	Dividends per Share 1928	Last Dividend Paid	Par
Anaconda	228	3.50	1928	$50
Andes	104	0.75	1928	No
Calumet & Arizona	52	7.00	1928	10
Calumet & Hecla	121	2.50	1928	25
Cerro de Pasco	98	4.50	1928	No
Chile	266	2.825	1928	25
Howe Sound	42	4.00	1928	No
Inspiration	88	....	1927	20
Miami	48	1.50	1928	5
New Cornelia	78	2.00	1928	5
Nevada Consolidated	268	1.625	1928	No
Phelps Dodge	204	7.00	1928	100
United Verde	118(*d*)	15.00	1928	No
United Verde Ex	45	2.00	1928	0.50
Utah	274	8.00	1928	10
Miscellaneous				
American Metal (*b*)	36	3.00	1928	No
International Nickel (*b*)	45(*d*)	2.50	1928	25
Kennecott (*c*)	246	5.25	1928	No

Name	"Small Scale" Mines: Output In Millions of Pounds	Dividends Per Share 1928	Last Dividend Paid	Par
Arizona Commercial	5	0.50	1928	$5
Boleo	26	....	1919	100 fr.
Consolidated Coppermines	21	....	....	$5
Copper Range	24	1.00	1928	25
Corocoro	15(*d*)	....	1922	10 sh.
East Butte	9	....	1919	$ 10
Engels	11	....	1926	1
Gatico	6	....	1924	12 pesos
Granby (*a*)	57	3.00	1928	$100
Greene-Cananea	36	2.00	1928	100
Magma	35	3.00	1928	No
Mason Valley	9	....	....	5
Mazapil	10(*d*)	....	1920	£ 1
Mohawk	21	6.00	1928	$ 25
Mother Lode	13	0.55	1928	No
Ohio Copper	4	....	1926	$ 1
Old Dominion	18	....	1918	25
Poderosa	6	....	1921	£ 1
Shattuck Denn	5	....	1920	No
Tennessee C. & C.	12	0.75	1928	No
Walker	10	....	....	$ 1

(*a*) Includes production of two distinct operations, neither "large scale." (*b*) Most of the income comes from other sources than copper. (*c*) Includes Braden "large scale," and Kennecott, "small scale." (*d*) Estimated.

what kind of mines were making money with copper selling at pre-war prices in a post-war market, and what kind were not. As already mentioned, all of the large-scale operations are listed, while the 21 companies engaged only in small-scale operations account for more than half of the total amount of copper produced by that group.

Of the fifteen large-scale companies, fourteen paid dividends in 1928. The fifteenth, Inspiration, paid dividends in 1927 and has since resumed payments. All three of the "miscellaneous" companies also paid dividends. Of the 21 small-scale companies, however, only eight paid dividends. Of the thirteen others, three companies have never paid dividends at all; one has not paid since 1918; two have not paid since 1919; two not since 1920; one has not paid since 1921; and one not since 1922. All of these companies are established producers, none having been operating for less than ten years, and the claim that they are are still in the development stage cannot therefore be made. They have had to sell copper at pre-war prices and have had to buy their own commodities—labor, machinery, and power—at post-war rates. Under these conditions, that they should fail to prosper is not strange.

Nor does this table take account of many of the important small producers that were operating and paying dividends during the war period, but that did not produce in 1928, not through lack of ore but because of the low price of copper. As has previously been pointed out, all of the large-scale mines are still in operation.

The conclusions arrived at in this article may be summed up in four sentences thus:

1. In the twenty years, 1909-1928, the price of copper showed practically no appreciation, although commodity prices increased on an average of 50 per cent.

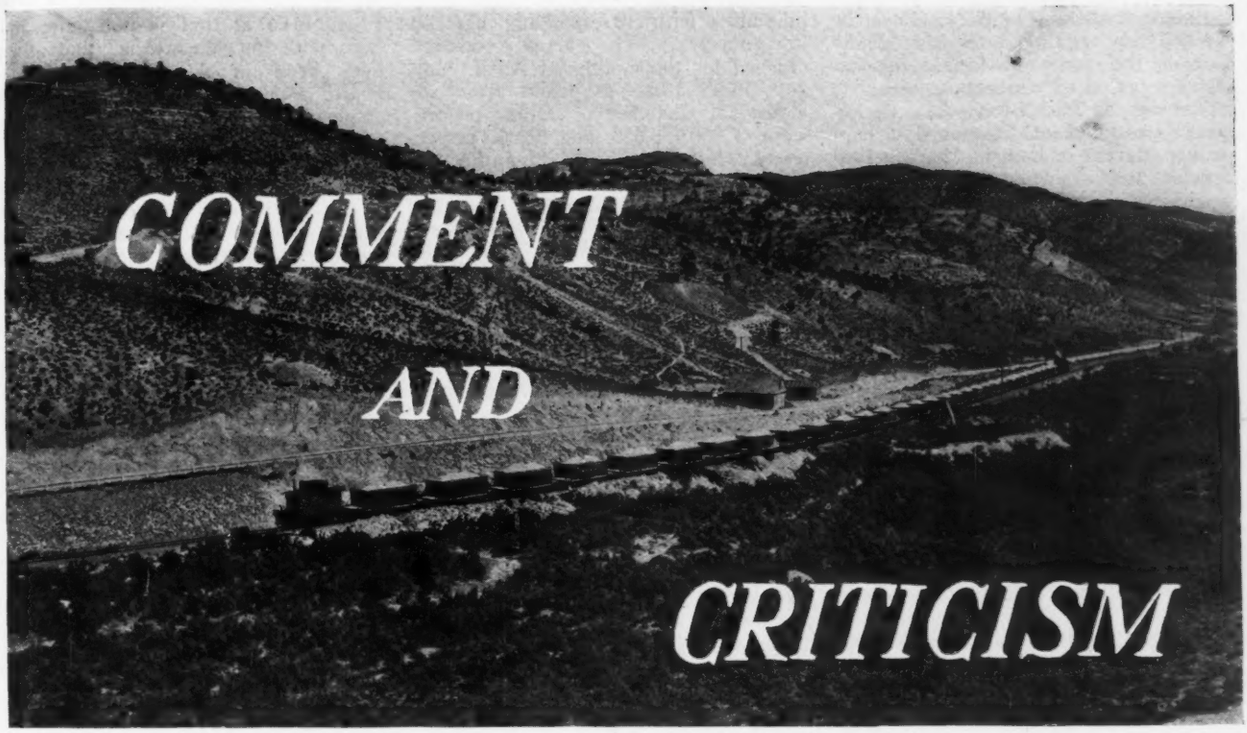
2. In the same period the amount of copper put out by the large-scale operations—those producing more than 40,000,000 lb. annually—greatly increased, whereas the amount put out by the small-scale operations was actually slightly reduced.

3. The large-scale operations were able to prosper under the low price, whereas the majority of the small-scale operations were forced to close down or to operate without profit.

4. And, therefore, the fact that copper did sell for pre-war prices in a post-war market may be directly attributed to the growth of the large-scale operation, coupled with increased technical efficiency.

It might be well for "experts" to keep these facts in mind when speaking of the "inordinate profits" or the "menace" of large copper-mining corporations.

A general view of the crushing plant of United Verde Copper at Clarkdale, Ariz. The coarse-crushing unit is in the right foreground.



Unemployment and the Census

To the Editor of "E.&M.J.":

It is with keen interest that we have read your editorial of April 6 on "Unemployment Statistics and the 1930 Census." It is encouraging that you have so clearly seen the significance of that part of the report of the Senate Committee on Education and Labor on the subject of unemployment, which advocated taking this opportunity to obtain a count of the number unemployed at a given date.

The Committee on Governmental Labor Statistics of the American Statistical Association has likewise been advocating the inclusion of questions in the 1930 census which will give this information. In previous censuses, notably 1880, 1900, and 1910, efforts were made to obtain information about unemployment, but the questions asked for too much. The enumerator was expected to find out how long a wage earner had been unemployed in the course of a year. Owing to the difficulties in securing accurate information, the effort to get any facts on unemployment was abandoned in 1920.

To eliminate this difficulty our committee has urged that census enumerators ask two questions related to unemployment—the first, "If you are ordinarily gainfully employed, are you now out of a job of any kind?" To this, the answer would be "yes" or "no," and it is altogether probable that there would be little or no error in the information thus obtained, showing how many of the workers in the population are definitely separated from jobs.

This, however, does not cover our whole need. Some who are not out of jobs may not be working today for pay. Coal miners, for instance, still on the payrolls of the coal company, may be at home idle without wages because the mine is not operating at the moment. The enumerator would, therefore, ask a second question—"If you hold a job of any kind, are you on lay-off without pay today?" Again the answer would be "yes" or "no." No information would be sought regarding the length of time unemployed in the course of the year, this being an exceedingly difficult fact to ascertain—as previous efforts of the census have shown—requiring a long interview and a superior memory on the part of the person questioned. By abandoning the effort, there would be more chance of getting the other questions accurately answered.

It is important to know not only the total number unemployed but in what occupations they are ordinarily engaged. So it would be necessary to add to the schedule the questions generally asked as to the trade, profession, or particular kind of work of the individual and the industry, business, or establishment in which he is employed or in which he was last employed if he is now out of a job. With the publication of this series of facts, we would have exact information as to the number out of work and out of wages under all the main industry headings such as manufactures, construction, agriculture, mines, trade, transportation, the professions, and domestic service.

The need for comprehensive census data has become greater because of the unforeseen and unanalyzed changes which are going on before our eyes in the growth of new industries and in the mechanization of innumerable occupations. It is no longer safe statistically to use samples of employment data or to make estimates without frequent checks based upon comprehensive information such as only the census can afford.

Not only should the federal government count the unemployed in taking the census of population, but it should make available the data on monthly trends of employment obtainable from the census of manufactures and similar information which it is hoped may be secured in the proposed new census of distribution.

If for 1930 the federal government will give us a bench-mark of employment and unemployment, all efforts to increase the security of employment of American wage earners will become susceptible of measurement of results. Without this bench-mark, all these efforts are more or less blind.

MARY VAN KLEECK, *Chairman.*
Committee on Governmental Labor Statistics, American Statistical Association.
New York, N. Y.

Early History of Nevada Consolidated

To the Editor of "E.&M.J.":

A friend has loaned me the series of articles by Arthur B. Parsons on the Nevada Consolidated Copper Company, published in *Mining and Scientific Press* in 1921. As I was connected with Nevada Consolidated in the early days of that company, I found the articles very interesting. I do not understand how I missed them at the time they were published.

Should something of the kind ever be worked up again, I would gladly furnish the author with information about a period of which little seems to be known. At least I have seen a number of misstatements in regard to happenings during it, both in Mr. Parsons' articles and elsewhere. That is, the period between the stopping of underground development in the Ruth mine, in the spring of 1906, awaiting the completion of the Nevada Northern Railroad, and the shutdown of all underground work on Oct. 25, 1907, owing to the failure of the Knickerbocker Trust Company, with which the company's funds were deposited.

For instance, Mr. Parsons speaks of Mr. Gray as being superintendent of the Ruth mine until 1907; and, on pp. 334, he says that Mr. Vanderhoff succeeded Mr. Gray in 1910. Mr. Gray must have severed his connection with Nevada Con. early in 1906, for I never met him. He was not at the mines in June, 1906, when I first visited them, in company with Mr. Requa, going in on the first regular train of the Nevada Northern when it was opened for traffic as far as Curry's Ranch. In June, 1906, Captain R. K. Toms signed a two-year contract to act as mine superintendent, beginning July 1, 1906. I went with the company at the same time as assistant mine superintendent. Mr. Vanderhoff succeeded Captain Toms in May, 1908, a few weeks before the expiration of Captain Toms' contract.

As I was connected with Nevada Consolidated only a year and a half, many details stand out in my memory in regard to that period; and, as I say, I would gladly try to be of service should anyone again write its history.

E. G. DEANE.

St. Petersburg, Fla.

Tube-Mill Duty on the Rand —A Correction

To the Editor of "E.&M.J.":

In Alfred James' "Christmas Letter," published in your Dec. 22 issue, he makes a statement which very much minimizes the value of the system of grinding developed by Messrs. Willey and Ewing, of the Anglo American Corporation, and described in a paper by Messrs. Davis Willey and Ewing for the A.I.M.E. several years ago. I think this error should be corrected.

At the head of the second column, p. 972, the statement appears: "Mr. Johnson claims for the same number of tube mills (twelve) an average monthly tonnage of 61,300 tons, against 50,900 tons at West Springs with identical percentage extractions."

Mr. Johnson was in error in stating that there were twelve tube mills used at West Springs when milling at the rate of 50,900 tons per month, for during the period which Mr. Johnson apparently had in mind, namely April, May, and June of 1928, only ten tube mills were in use at West Springs, although in August, 1928, they completed the installation of two additional tube mills, with corresponding increases in tonnages. The actual tonnages crushed for the months of April, May, and June, 1928, as taken from the Transvaal Chamber of Mines returns, were 47,000, 53,600, and 52,200 respectively, which gives an average of 50,933 tons. Modder East tonnages for the same period were 61,000, 59,000, and 60,000, or an average of 60,000 tons. Mr. James' remarks, made in the belief that West Springs used twelve tube mills, lose their point entirely when it is recognized that only ten tube mills were used, the capacity per tube then being much the same for West Springs and Modder East. A READER.

Johannesburg, South Africa.

On Designating That Border Material

To the Editor of "E.&M.J.":

One encounters again in your specular columns the heroic search of the inarticulate for a word to represent the border material between ore and waste.

The effort thus far put forth seems to have been guided by the necessity(?) for the word to have its name and return address plainly stamped in one corner. "Gangue-ore"; "Abore"; "Subore"; "Mineral substance." Such words leave one cold, for their obvious artificiality. Like begets like, and the ant will not cohabit with the scorpion.

At the outset, may we not take a lesson from the coiners of trade names? The few artists of that gentry have discovered that a coined word must be spontaneous, easily pronounceable, inconspicuous, not offensively undignified, and a caterer to all classes of people. Is it necessary to mention "kodak" and "coca cola" or to deplore "Kaffee-hag?"

Outside the trade field, that euphemistic and graceless word "scofflaw" seems to be making heavy weather of it, while on the other hand, "jazz" is a truly spontaneous word that seems to be winning its way to recognition somewhat beyond New Orleans. "Dollar" is a word that no one can explain the source of, yet, after a manner of speaking, it has filled the bill. "Chortle" is in the dictionary because Lewis Carroll had imagination. "Quiz" is a really admirable word that was fathered by a wager. In our own noble profession, "muck" is a word that is fairly well understood by those skilled in the art. The geologists have given us "hypergene"; surely this did not exhaust their philological resources.

We can always borrow from the dead languages, as we did to name the telephone and the automobile, and would then have some such word as "terramace" meaning lean ground; or from the live languages, as we did when we dignified the street into the avenue and the pond into the reservoir. We borrowed "caliche" from the Spanish-Americans and understand it, and gave them "tren" and any number of other words in return. With neither compunction nor discrimination, we borrowed "Ajo" to name a mining camp, which even at that is not quite in a class with the "gasfitteria" that advertises itself in Antofagasta. *Magro, pobre, provecho,* and many other examples occur to one.

Or may we trump up a term from the same source as muck: Fringe, or fribble, or margin, or short, or prosit, or duff—I haven't the heart to suggest woolworthite. By the bye, I'd bet that the Cornishmen have had a word for it ever since the dawn of the Christian era, or at least ever since the dawn of Cornishmen.

In all seriousness, why not an etymological memorial to those who have had the hardihood to make ore of waste—to those epic enterprises where Spartan pioneering has won profits from the very material we are now seeking to name? By way of reasonable illustration, if not suggestion, I mention jackling, miami, and juneau, though perhaps they do not yet have the right historic perspective.

Somewhere in Mexico. ENGINEER.

[*Engineering and Mining Journal* accepts the suggestion and submits for approval or criticism the word "junore," in compliment to the distinguished president of the A.I.M.E., and in tribute to his success in transforming "waste" into "ore" at the Alaska Juneau mine.—EDITOR.]

Still Another Suggestion

To the Editor of "E.&M.J.":

Here is another suggestion as to a name for our mineralized rock which approaches the bounds of ore. Almost all industry produces culls or seconds, which may or may not be salable. The material in question may some day be mined at a profit, but for the present it is culled from the ore. Or shall I say it is "Culdor"? RALPH H. CLELAND.

Timmins, Ont.

Everything But Romance in Foreign Mining Camps

To the Editor of "E.&M.J.":

In the issue of Feb. 9, in the "Searchlight Section," I noticed an advertiser using the term romantic in describing Mexican and South American mining camps. I have worked at various camps in both places and have found them decidedly the opposite. In Peru, where I am now working, the conditions, although not romantic, are satisfactory in every way and the salaries are higher than in the States. The "Gringo," on contract in foreign countries, invariably has good living conditions, good food, and plenty of recreation. Even in camps at 14,000 ft. elevation the climate is healthful; a man in good physical condition will never feel bad effects.

I can safely say that nine-tenths of the people who are working in Mexican and South American mining camps are fully satisfied in every way, and the other tenth are never satisfied anywhere. FRANCIS W. KENDALL.

Cerro de Pasco, Peru.

BY THE WAY

Brave Rescue in Yukon Mine Is Recognized

ON March 20, 1926, Sinclair Dunnett and John McHugh were working at the bottom of a 35-ft. shaft on the Dixie claim in the Mayo district of the Yukon. They ignited seven fuses to blast the rock at the foot of the shaft and started up the ladder to escape from danger. Dunnett was leading and had just reached the top when he missed his hold and plunged downward head foremost. McHugh, who was half-way up, braced himself on the ladder and with his shoulder managed to break Dunnett's fall, causing him to turn over in the air so that he alighted feet foremost instead of on his head. That was presence of mind. Straight up was daylight and safety; straight down was darkness and imminent death. At any moment the blasts might explode. But without an instant's hesitation, McHugh slid down the ladder, pulled the unconscious Dunnett out from the midst of the hissing fuses, put him on his back and started up again. It was a herculean task for McHugh to climb with his unconscious mate and one which might never have been accomplished in time had not John Abraham, the third partner, slid down the ladder to meet McHugh and help him up. With their united exertions they got Dunnett about half-way up the ladder when the blast exploded, throwing rocks all around them, but fortunately none of them was injured.

McHugh had twice saved the life of his friend, first by breaking his fall and then by getting him out of the reach of the dynamite blasts. The Royal Canadian Humane Association was apprised of the circumstances and awarded McHugh the society's medal.—*Natural Resources, Canada.*

The Questionable Prospectus Is Outdone by Nature

NOT INFREQUENTLY a prospectus of a questionable mining promotion appears that describes a certain orebody as containing not only an unusual number of different metals but also several that are not associated in nature. In such instances, it is evident that if some one's imagination has not been given free rein, deliberate fraud is intended. Even in the most flagrant cases of this kind, however, seldom is a list of fourteen different metals claimed for any real or fictitious orebody. Nevertheless, such an imposing number of metals has recently been discovered in a very common liquid "orebody"—namely, in milk.

Drs. Jacob Papish and Norman C. Wright, of Cornell University, according to *Time*, announce that with the aid of the spectroscope they have determined the presence of small but definite amounts of the following metals in milk: strontium, vanadium, rubidium, zinc, copper, titanium, lithium, calcium, magnesium, potassium, sodium, iron, aluminum, and manganese. In addition, the following non-metals were found: chlorine, iodine, boron, and phosphorus.

The announcement causes one to speculate as to the source of these metals in milk, and to what degree they are important in human metabolism. But while awaiting enlightenment from scientists on these subjects, we shall still be chiefly interested in the depth of the layer of cream.

Byrd Names One of His Flying Fields for C. V. Bob

COMMANDER BYRD has named the two large flying fields on the north and south sides of the Barrier for two among the best friends of the expedition.

"I have decided to name the landing fields of Little America after two men who have done untold things for the expedition and without whose assistance the expedition would have been impossible, Charlie Bob and Raymond Fosdick," the commander said.

"These are probably the largest flying fields in the world. The north field will be the Charlie Bob Field and the south field the Raymond Fosdick Field."—New York *Times.*

Another Lesson on the Fire Hazard

"THE fire started in the engine room, evidently from an oil-soaked floor, and spread rapidly through the mill and to the derrick and hopper." A concentrator erected at a cost of $75,000 was destroyed; two lives were lost, and eleven men were imperilled. This, in brief, is the story of a recent mine disaster. The lesson taught by former conflagrations — that cleanliness and order are not fads but good business—has yet to be learned by the directing officials of many operating companies. A heavy responsibility rests on those who permit the continuance of conditions such as those disclosed above, including any insurance company willing to accept the risk involved.

Reward Mine to Furnish White House Paper Weight

PRESIDENT HOOVER soon will have a desk weight on his desk in Washington, D. C., made from a piece of gold quartz taken from the Reward mine, in Nevada County, Calif., where he worked when first beginning the engineering career that landed him in the White House.

The ore was received recently by R. L. Kimmel, manager of the mining department of the Sacramento Chamber of Commerce. It was sent by the Nevada City Chamber of Commerce through the courtesy of Emil J. N. Ott, assayer, whose father was superintendent of the Reward mine when Hoover was employed there.

The ore that will go into the desk weight to be sent to the President is reputed to have been mined about the time Hoover was in Nevada County.

A replica of the original gold flake found by James Marshall will be mounted on the quartz.—*Sacramento Bee.*

Why Slide Rule Salesmen Do Not Visit Ajo

According to a recent official report, based on 223 drill holes, New Cornelia ore reserves amount to 976,188 tons of oxidized ores averaging 1.31 per cent copper, and 113,262,128 tons of sulphide ore, averaging 1.25 per cent copper. Even if only 113,262,127 tons of the sulphide ore can be extracted in productive operations, New Cornelia will still be a great mine.

Consultation

Employment in Northern Rhodesia Desired

"Recent issues of 'E.&M.J.' have given some very interesting as well as inspiring accounts of activities in the South African copper fields—more specifically Northern Rhodesia. Would you kindly inform me as to whether or not there are American interests operating there—if so, the names of such interests and, if not, the names of British companies with whom I could correspond regarding employment. I will appreciate very much any information you may be able to send me on these questions."

No American companies are operating in Northern Rhodesia, although the American Metal Company, 61 Broadway, New York City, holds a substantial interest in Roan Antelope Copper Mines. The following companies control the major current operations in Northern Rhodesia:

Roan Antelope Copper Mines, Ltd., N'Dola, Northern Rhodesia.

Rhodesian Congo Border Concession, Ltd., N'Changa, Northern Rhodesia.

Bwana M'Kubwa Copper Mining Company, Ltd., Bwana M'Kubwa, Northern Rhodesia.

Loangwa Concessions (Northern Rhodesia), Ltd., Broken Hill, Northern Rhodesia.

Broken Hill, Northern Rhodesia.

Rhodesian Selection Trust, Ltd., N'Dola, Northern Rhodesia.

Tanganyika Concessions, Ltd., Friars House, New Broad St., London, E.C. 2, England.

Ingenious Machine Makes Efficient Gri

Construction and working details of air-operated casting unit, which produces 1,400 two-inch balls per hour, with small force of unskilled labor, designed and described

USE of cast-steel chilled balls as a grinding medium in ball mills is by no means new. To make it possible, however, for companies situated in remote places, or where high freight rates prevail, to use them and at the same time cut their costs, calls for devising a simple and economical method of making these balls in their own foundries, existence of which is taken for granted.

The desired objective can be attained with the aid of a machine that, first of all, can produce in large quantities a tough, smooth-surfaced ball sufficiently strong to resist two or three blows under a steam hammer before breaking; and which is cheap and can be easily operated by unskilled labor.

Fortunately, I have had rather extensive experience in this work, having operated with two machines of different types, one having the not very efficient solid water-cooled molds which were opened and closed to receive the molten alloy by a clamp and lever device, and the other the much more efficient machine having vertical, water-cooled, revolving molds which are operated by a compressed air cylinder. Both machines required an extra operator to turn the molds into their working position. To eliminate this extra man and at the same time increase the production capacity by 50 per cent, I have designed the automatic, water-cooled, horizontal type machine described in the following:

As will be seen from the accompanying drawings, the machine consists of four main parts—namely, a mild steel frame; two horizontal revolving and water-cooled mold frames with bolted-on molds; a turning mechanism; and an air cylinder.

The frame is made of 6-in. channel beams, all arc-welded except channels B and B_1 (Fig. 1), which are bolted on so that the molds, frames, and crossheads may be taken out and repaired whenever necessary.

Mold frames A and A_1 (Fig. 1) and the four right and four left molds required are made of cast iron. To obtain the smooth-surfaced 2-in. ball mentioned, the ball molds are milled with a specially made cutter, and the air channels are planed either V-shaped or semicircular. A $\frac{1}{16}$-in. sheet-rubber gasket will keep the molds water-tight and prevent water from coming in contact with the molten metal, which would be rather dangerous. The life of these molds I have found to be between six and nine months, according to treatment. Being made after precise stencils, the molds are certain to fit. A pair or two pairs should always be kept in stock for replacement.

The cooling system is simple. Water

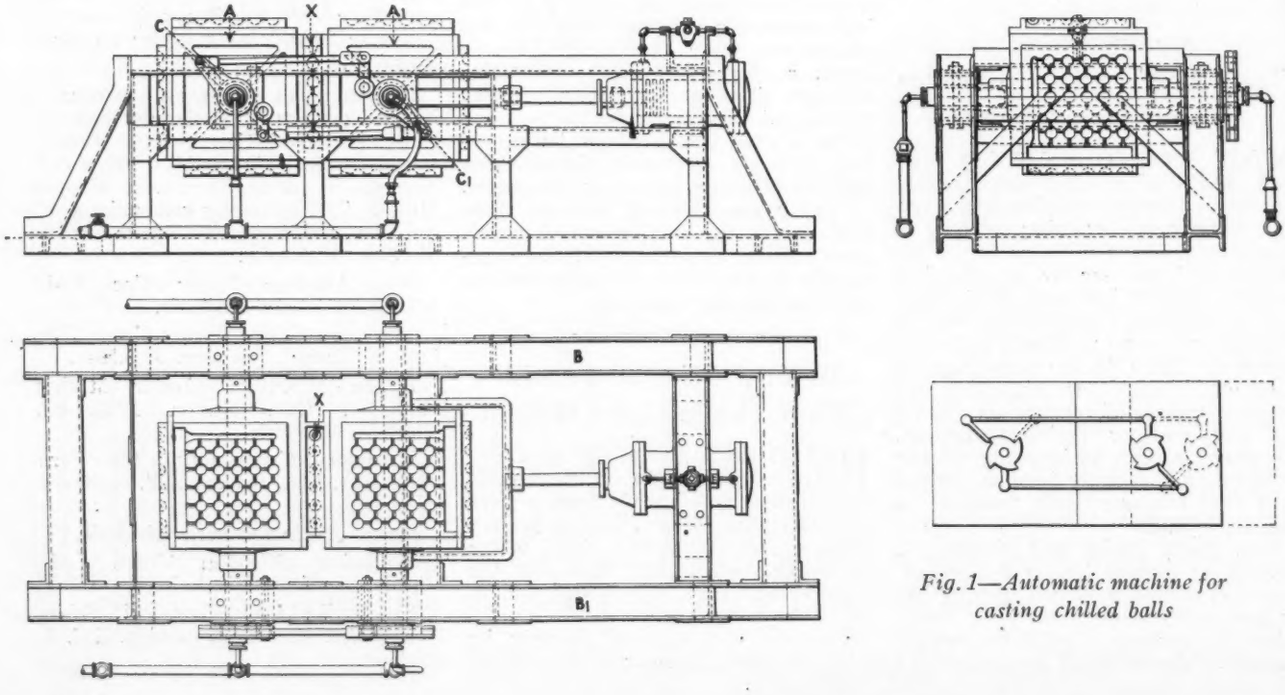
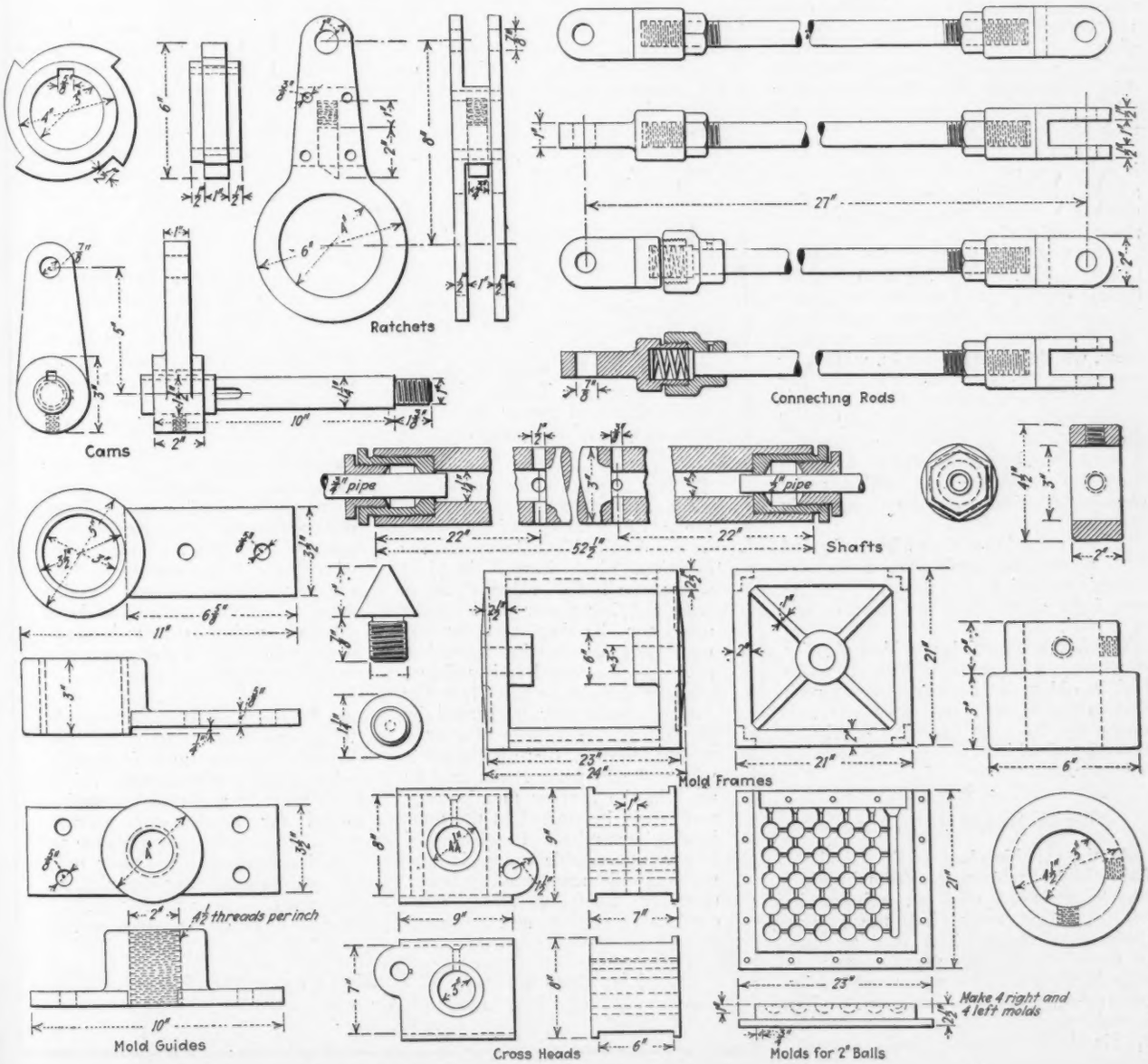


Fig. 1—Automatic machine for casting chilled balls

Grinding Media From Steel Scrap

by JOHN B. HUTTL,
Mine Master Mechanic, New York & Honduras Rosario Mining Company, Honduras, Central America

Fig. 2—Details of machine for automatically casting grinding balls



enters the partly hollow shafts through a ¾-in. pipe and leaves them through four ½-in. holes; it fills up the frames, enters the shafts again through four ⅜-in. holes, and leaves through a ½-in. pipe. The flow can be regulated with a ½-in. globe valve on the discharge pipe, and two stuffing boxes keep the connections water-tight. As frame A_1 also goes through a sliding motion, rubber hoses are used for the inlet and outlet connections. The shafts are press-fitted into the mold frames.

Ratchets C and C_1 (Fig. 1) and the two connecting rods, of which one is equipped with a flexible joint, constitute the automatic turning mechanism.

Frame A, with its molds, is turned 90 deg. to the right in response to a pulling force effected by the backward stroke of the piston. To obtain the necessary clearance the frame A_1 should be allowed to open at least 4 in. before ratchet C grips cam C and begins to turn A. Ratchet C_1 at the same time has been placed in cam C_1, and frame A_1 also is turned 90 deg. to the left during the forward stroke. As this movement is obtained through compression, and no cam clearance can be given as to ratchet C, the flexible connecting rod allows the two molds, still 4 in. apart, to be pressed together, after which they are ready to receive the molten metal.

The air cylinder is also made of cast iron, having a 6-in. diameter piston and an 11-in. stroke; also an extra long stuffing box which acts as a guide for the 2-in. piston rod.

One man for pouring the metal at point X (Fig. 1), one boy for operating the air cylinder, and another for greasing the ball molds with old, used black oil, constitute an adequate working crew, which, when broken in, will easily produce 1,400 (and more) balls per hour with the machine.

The balls, cooling quickly, fall out of the molds during the turning of the frames A and A_1, and are removed to the shop for separating and for the cleaning required to make them ready for use.

I recommend that the molds be heated with a gasoline torch before the machine is started, as this assures perfectly cast balls right from the start of the operation.

Cheap raw material, and ideal also for conversion into grinding balls, is to be had in old rock-drill parts, worn rock drills, or any steel scrap, of which every company has an abundance lying around and which is often considered a nuisance.

Drip Stops Frothing

At the cyanide plant of the Kirkland Lake Gold Mines, trouble from frothing was experienced with an agitator in which the air enters into the hollow shaft from above. The frothing was so excessive that the gears were running in sludge. This was remedied by running a slight drip of barren solution into the top of the hollow shaft beside the air pipe. This drip killed the froth.

It Pays to Buy Power—

1 It pays to buy power—if the rates are right—in plants of small and of moderate power demand where there is little or no need for heat for manufacturing processes or for the heating of buildings.

2 It pays to buy power in plants even where power can be made more cheaply than the purchased power can be bought, under certain special circumstances. Where to make power economically would require a considerable capital investment for power equipment or improvement and also where, at the same time, the limited capital available could be turned over much more rapidly in improving the production branch of the business.

3 It may pay to buy power in plants of large power consumption where a highly developed superpower system makes the cost of purchased power almost as low as that at which it could be generated on the owner's property.

4 It may pay to buy power in plants of any size where the owner's business policies are unsettled or where his business may be growing so very rapidly that he does not desire to risk building a power plant which in a short time would be unsuited to his needs, not only in size of steam generating and power units, but also in type of equipment.

5 It may pay to buy part of the power requirements. There are two general sets of conditions favorable to this solution of the question. First, there is the plant wherein all the exhaust steam from existing power units can be used for heating and process work but where the byproduct power so generated is insufficient to meet requirements. Here the best economy may be served by purchasing the balance of energy needed. Second, there is the plant where the exhaust steam can be used in the heating months only and would be wasted in the non-heating months. Purchase of power at suitable rates in the warm months may result in better economy than operating non-condensing engines and turbines.

It Pays to Make Power—

1 It pays to generate and not to buy power, in the smallest to the largest establishments, when all of the exhaust steam from the power units can be utilized for heating or for process work. Exhaust steam can now be delivered at high pressures (100 to 300 lb. and higher) from power units served by high-pressure boilers. Hence, the number of manufacturing plants which can profit by generating their own power has largely increased. Even a little factory plant with a 100-kw. engine generator set, using all its exhaust steam, may generate a kilowatt-hour for one-half pound of coal above the quantity that would be used for the heating alone with the engine shut down.

2 It is usually cheaper to make than to buy power when the steam heating, or the process load which could be supplied by exhaust steam, is relatively large in comparison to the power load. Thus if one-half of the engine or turbine exhaust be utilized to replace direct steam from the boilers, the fuel cost of power is almost halved. This applies to plants of all sizes. Where the heating load is fluctuating or seasonal, but of sufficient amount, high efficiency can be maintained by combining condensing and non-condensing power units to balance the requirements at all times. Or such a steam balance may be secured by use of the bleeder type of turbine-generator.

3 It may pay to generate instead of to buy power when there is a moderate to large power demand continued for a good part of the 24 hours, even when there is no heating load or use for exhaust steam. Under these conditions the overhead charge per kilowatt-hour is small and a simple, efficient power plant can be operated economically.

4 Another condition favorable to making power on the owner's property may frequently exist when a considerable boiler plant must in any event be maintained for heating or process work. It may here be possible to install an economical power unit without adding boiler capacity, so that there is no added overhead charge except for the power unit.

These statements, by D. M. Myers, are reprinted from an article in "Factory"

Personal Notes

Robert E. Tally, general manager of United Verde, at Jerome, Ariz., is in New York for several weeks.

George W. Paymal is now working tailing deposits at the Wagner and Strode mines, Trinity County, Calif.

L. E. Wemple, president of the Illinois Zinc Company, has returned to New York after six weeks' absence in Europe.

William Young Westervelt has recently been in California, part of the time in a remote mining camp near Death Valley.

W. T. Milliken, mining engineer, of Denver, Colo., is in charge of the work of reopening the North London mine in the Alma district of Colorado.

A. W. Head, of Jefferson, Colo., has been appointed commissioner of Park County, Colo., by Governor Adams. He succeeds the late **G. S. Singleton.**

P. G. Beckett, general manager of the Phelps Dodge Corporation, has been elected president of the Apache Power Company, succeeding the late C. E. Mills.

E. A. Strong, of Denver, and **W. C. Page** have gone to London, where they will be associated with **A. G. McGregor** in the design of the Roan Antelope concentrator.

L. B. Smith has been appointed mine superintendent at Wright-Hargreaves Gold, in the Kirkland Lake district of northern Ontario. He was formerly manager of Barry Hollinger, in the Boston Creek district, and has had considerable experience in the Rocky Mountain section of the United States.

OBITUARY

William S. Sultan, pioneer Arizona mining man, died recently in the Copper Queen hospital at Bisbee. Mr. Sultan was the first mayor of Globe. He was connected with Arizona Commercial for many years, and was manager of Globe Light & Power.

Fred Smith, 94 years old, one of the pioneer mining men of the Michigan copper district, died in Houghton on April 30 after an illness of five weeks. Before his retirement, in 1913, he had been for many years general manager of the Mohawk and Wolverine properties. He was a native of Germany and came to the district in 1855. He held positions with several mining companies, and in 1877 became the agent for Allouez Mining, holding this position until the closing down of the mine in 1892. Before this event he had been placed in charge of the Wolverine and in 1898 he also assumed management of the Mohawk.

George T. Coffey died in Oakland, Calif., on May 8. He was 58 years of age. Mr. Coffey was born at French Corral, San Juan Ridge, Nevada County, and spent his boyhood and early manhood in the heart of the hydraulic mining country. He continued in the hydraulic mining business all his life. In 1897 he went to Dawson, Y. T., to take charge of the hydraulic mining operations of an English company, and operated the property until 1905, when it was taken over by Yukon Gold. He was retained as superintendent of hydraulic mining operations and later became manager of the property. He helped to perfect the use of manganese steel in place of block riffles and worked out many improvements in present-day practice of hydraulic mining. Under his charge was a ditch system, 73 miles in length, suppying 5,000 miners' inches of water. He remained in Dawson until 1926. During his management 40,000,000 cu.yd. of gravel was worked by hydraulic methods from the White Channel. Since 1926, he had been living at Oakland, engaged in consulting practice.

An Appreciation of Francis L. Bosqui

FRANCIS L. BOSQUI, consulting metallurgical engineer, internationally known for his achievements in cyanide practice, more particularly in the treatment of gold ores in the United States and South Africa, died May 4th at Johannesburg. At the time of his death, Mr. Bosqui, as consultant to the South African Townships Mining and Finance Corporation, composed of some of the leading mining groups in Johannesburg, was engaged in developing an improved method for treating platiniferous ores of the Transvaal. He was also retained as consulting metallurgist by several of the prominent mining companies of the Rand at this time.

After graduating from the University of California, Mr. Bosqui took the Degree of M. D. at the College of Physicians and Surgeons, Columbia University. He started his work in San Francisco, but finding the practice of medicine was becoming distasteful, he accepted, in the summer of 1894, a position on the staff of the Standard Consolidated Mining Company at Bodie, California, and began learning cyanide treatment under the tutelage of Mr. C. W. Merrill, who shortly withdrew, leaving him in full charge of the 100-ton plant. Subsequently other cyanide plants were erected under his supervision by the company.

During 1899 and 1900 he was engaged in designing cyanide plants for the Liberty Bell Mining Company at Telluride, Colo., for the Smuggler Union Mining Company, in the same district, and for the Camp Bird Mine, at Ouray, Colo. Consulting metallurgical practice in San Francisco from 1902 to 1905 was followed by the appointment of metallurgist to the Combination Mines Company at Goldfield, Nevada. Later, as metallurgist with the Goldfield Consolidated, he achieved his outstanding work in this country, when he devised the metallurgical scheme for the company's new 100-stamp mill and cyanide plant.

In 1909 Mr. Bosqui accepted a position at Johannesburg on the staff of the Rand Mines, Ltd., and a year later was appointed consulting metallurgist of this group, the largest on the Rand. During his six years' tenure of this position he successfully revised, and in many ways reduced the costs of, the generally accepted methods employed at the time in the chemical treatment, mechanical filtering, etc., of the Witwatersrand gold ores. He also designed new plants for the Modderfontein B and New Modderfontein Companies.

Mr. Bosqui returned to England in

FRANCIS L. BOSQUI

1916 and there joined the directorate of Chas. Butters & Company. In 1919 he went to New York to take charge of the American interests of that firm, which, in co-operation with the Central Mining & Investment Corporation, had undertaken to introduce the Tainton process in the United States. The Anglo-American Corporation engaged his services in 1927 for the metallurgical side of their examination of the Mount Isa Mine, in Australia. On his return to South Africa he undertook the work on which he was engaged at the time of his death.

Frank Bosqui was a warmhearted genial man with a keen sense of humor and of so engaging a personality that his assistants became devotedly attached to him. That he was gifted with intellectual ability of no mean order was abundantly shown by his rapid and successful switching from the medical training of years to the technical, chemical and mechanical problems of a new discovery in precious metal ore-treatment; while his book on the cyanide process published in 1897 was a recognized authority for many years.

Ever a lover of good music, he was in his early years an accomplished pianist, and in later life his chief recreation lay in attending symphony and other concerts where he could listen to the best performers.

Being in London during the later years of the war, he and another Californian raised the needed funds to establish "California House," which flew the State Flag and was supported largely by contributions from Californians. Here wounded Belgians were cared for, and on recuperation were aided in finding work.

He leaves in Johannesburg his wife and a son trained to follow in his footsteps, having been his father's chief assistant in all his recent work; also a younger daughter now in this country.

And from the Pacific Coast to the heart of South Africa he leaves a host of sorrowing friends.

T. H. LEGGETT.

INDUSTRIAL PROGRESS

Insuring Safety in Welding—I

Hazards to Health to Which Workmen Are Subject—How to Minimize Them

WELDING HAZARDS, affecting the health of the operator, are created by injurious light rays and by fumes and gases produced by the action of the heat evolved during the process upon the material welded. These health hazards are classified as follows in a pamphlet entitled "Safety in Welding," recently issued by the Metropolitan Life Insurance Company's Policyholders' Service Bureau:

1. Ultra-violet rays.
2. Infra-red rays.
3. Poisonous substances such as lead which may be volatilized by heat.
4. Poisonous gases, such as carbon monoxide, which may be generated by faulty combustion.
5. Exhaustion of oxygen in air when welding is carried on in small and poorly ventilated spaces.

(1) Ultra-Violet and (2) Infra-Red Rays

To understand the possible harmful actions of the light from the welding flame or arc, a brief discussion of light rays is necessary. If we pass ordinary light—sunlight—through a glass prism, it breaks up into the seven primary colors: violet, indigo, blue, green, yellow, orange, and red. Light, X-rays, and radio are all forms of radiant energy. Wave lengths of radiant energy vary tremendously, some being exceedingly small and measured in millimicrons—a millimicron being one thousand millionth part of a meter (1.093 yd.).

The human eye sees as light radiant energy, the wave lengths of which range from approximately 390 millimicrons to 770 millimicrons. The violet is at the shortest end of this range, the red at the longest.

Rays with shorter wave lengths than the violet are called ultra-violet. The wave lengths for this group extend from about 14 to 390 millimicrons.

Rays whose wave lengths are longer than red and which extend from about 770 millimicrons to 0.314 millimeter are called infra-red.

Although we cannot see ultra-violet and infra-red rays, they are active and powerful and are usually coexistent with excessive radiance. As the welding flame, or arc, is rich in both of these rays, the welder must be protected from them.

Ultra-violet rays are chemical in their action, and cause intense irritation of the eyes and burns of the skin, similar to sunburn. Snow blindness, desert blindness, and the "eye flashes" of welders are one and the same condition, all due to the action of ultra-violet rays upon the eye; their effects can be very painful and cause disability for several days, though usually they do not cause permanent damage.

Infra-red rays act upon the eyes simply as heat, but may cause permanent damage. There is little definite evidence that welding may cause cataract, similar to glass blower's cataract, but it is probable that prolonged exposure to infra-red rays may cause haziness of the cornea (part of eyeball).

Two Groups of Welding Processes

Welding processes may be placed in the following two groups so far as the effects of radiant energy are concerned:[1]

1. Processes requiring only a moderate reduction of visible radiant energy, such as oxyacetylene and oxhydrogen welding and cutting, and electric resistance welding.

2. Processes necessitating a large reduction of visible radiant energy—electric-arc welding and cutting.

For the protection of eyes from ultra-violet rays, black, amber, green, and greenish-yellow glasses are best, especially greenish yellow.

For protection against infra-red rays, deep-black, yellowish-green, sage-green, bluish-green, and gold-plated glasses are best.

For intense radiance, the darkest glasses possible should be used; black, green, and yellowish green, as these not only cut down the light but protect from both ultra-violet and infra-red rays.

The National Safety Code for the Protection of the Heads and Eyes of Industrial Workers specifies that for the first group goggles, face masks, helmets, and shields are permitted. The goggles may be of the rigid, non-adjustable bridge type, with or without side shields, or with flexibly connected lens containers shaped to conform to the face. Whatever variety be used, a heat-insulating material should be used on all parts that touch the skin, to avoid burning. Goggles should be made of material capable of being cleansed and sterlized.

Face masks or helmets of standard type may be used. Regardless of type of goggles or shield, the lenses should not transmit more than 1 per cent of radiant energy of any wave length less than 406 millimicrons, and not more than 50 per cent of the total radiant energy from the standard source.

Goggles Insufficient Protection for Arc Welding and Cutting

For the second group, only the helmet or the hand shield are permissible, as goggles do not give sufficient protection. The lenses should transmit not more than 1 per cent of the radiant energy of any wave length less than 406 millimicrons, not more than 1 per cent of visible light, and not more than 10 per cent of total radiant energy from the standard source. (The standard source used in these specifications is a 200-watt, 110-volt, gas-filled tungsten filament lamp, operating at 0.8 watt per spherical candle.)

Purchasers will hardly test the lenses they buy, but in purchasing protective equipment for either the first or second group of welding processes they should insist that the lenses comply with the specifications of the national code as published by the Bureau of Standards. Many reliable dealers can supply standard equipment, but the purchaser should always make clear the type of welding for which the equipment is to be used, so that full protection will be assured the operator.

Persons Near By Must Be Protected

In all welding operations, particularly where the electric arc is used, care must be taken to protect the welder from reflections of the arc from side walls, and persons working near by must be protected. Where welding is regularly done indoors, booths should be provided for each welder. These may be of a portable or "take-down" type, consisting of canvas on a metal pipe frame. The canvas should be painted to render it opaque and also to prevent light reflection. Zinc oxide, combined with lampblack to produce a bluish gray color, is advisable. For street or outdoor work, a portable booth should be placed around the electric arc welder.

In using the electric arc, care must be taken to prevent the skin from being burned, as the arc is very rich in ultra-violet rays. Hence, the necessity for a helmet or shield to protect the face

[1] "National Safety Code for the Protection of Heads and Eyes of Industrial Workers."

as well as the eyes, and high gauntleted gloves of non-inflammable material to protect the hands. No part of the skin should be exposed. Clothing should be protected from sparks by a leather or asbestos apron.

POISONOUS SUBSTANCES AND GASES—EXHAUSTION OF OXYGEN IN AIR

The principal and typical hazard included under *(3)* in the classification in the first paragraph of this article is lead poisoning. It occurs most commonly when metal sheets, covered with lead paint, are being cut or scrapped by either the oxyacetylene flame or electric arc. The resultant heat volatilizes the lead in the paint. If the welder inhales the lead fumes, rapid and severe lead poisoning may result. This has come to be recognized as an important industrial hazard, and many cases have been reported, both in this country and abroad, in connection with scrapping ships. Likewise, welding or cutting brass or zinc may result in "zinc chills." This has occurred in welding galvanized sheets.

The hazards included under *(3)*, *(4)*, and *(5)* commonly occur when working in close or confined places with insufficient ventilation. This may cause trouble in one or two ways: poisonous fumes or gases caused by the welding or cutting are not carried away and affect the operator, or the oxyacetylene flame may reduce the available oxygen in the air. In some instances, carbon monoxide is said to have been formed during welding under unfavorable conditions, with fatal results to the welder.

Special care, therefore, is advisable when welding or cutting is to be carried on in the confined spaces of ships, inside boilers or tanks, or under similar conditions, so that vitiation of the air may not cause an accident or illness. Welders should not be allowed to work under such conditions without supervision and, if possible, provision should be made for artificial ventilation by fans or other contrivance. In the electric arc process, red oxide of iron is produced as a fine brown dust in the air. This is not dangerous, however, but is annoying to the employees. It can usually be taken care of in an adequate manner by the existing exhaust system.

Where welding or cutting involves exposure to lead fumes for any length of time, the following standard preventive measures against industrial lead poisoning are suggested:

Welders should be re-examined at weekly or fortnightly intervals, so that if they are taking lead into their systems the fact may be detected before serious results follow. They should be induced to wear a gas mask especially designed to give protection against lead fumes, or a helmet with an air tube leading to a fresh air supply. Goggles can be worn with either gas mask or helmet. Although these devices are uncomfortable when worn in close or confined places, their use should be insisted on: otherwise poisoning is almost inevitable.

(To be continued)

INDUSTRIAL NOTES

On May 1 the Chicago district and central division offices of various units of the Union Carbide & Carbon Corporation moved to the new 40-story Carbide & Carbon Building, at Michigan Ave. and South Water St., Chicago.

H. Kramer & Company, Chicago, a smelting company specializing in ingot brass, has purchased improved property adjoining its present plant and headquarters. All of the present space will be devoted in the future exclusively to manufacturing facilities, thus providing room for the erection of two new furnaces of 50 tons' capacity each.

On May 1, 1929, E. D. Bullard Company, manufacturers and distributors of the hard-boiled hat and mine and industrial safety equipment, has changed its corporate name to Bullard-Davis, Inc. (of California). There is no change in ownership. Bullard-Davis, Inc., has established a sales office in Tulsa, Okla., in charge of J. J. Delahide. E. W. Bullard, president, announces that the office in Salt Lake City will be managed by J. F. Coombs. The Los Angeles office will continue under the direction of K. S. Butler and A. A. Castle.

The Krogh Pump Company, of San Francisco, has been consolidated with the Kimball Pump Company, of Los Angeles, and the new company will be known as the Kimball-Krogh Pump Company, R. M. Schlegel, formerly president of Kimball Pump, is president of the new company. Both companies have been representative pump-manufacturing concerns on the Pacific Coast for a number of years, and their joint facilities both at San Francisco and Los Angeles will be maintained as heretofore.

Through the purchase of adjoining property, the Leeds & Northrup Company has secured an additional 190,000 sq.ft. of property in Philadelphia, including approximately 85,000 sq.ft. of additional floor space in a one-story building of saw-tooth roof construction. The new building will be made integral with the present building by means of a connecting wing.

An existing one-story wing of the Brown Instrument Company plant, in Philadelphia, will be demolished and a new two-story and basement building will be erected on the site. Also, a new central wing of two stories and basement will be constructed. The additions will be of reinforced concrete throughout. They will cost about $200,000.

PATENTS

FLOTATION REAGENT. No. 1,711,087. April 30, 1929. T. H. Donahue and F. F. Frick, Anaconda, Mont.

Production of a flotation reagent by treating an aqueous xanthate solution with an excess of chlorine.

TREATMENT OF ORE DUST. No. 1,711,153. April 30, 1929. C. V. McIntire, assignor to Consolidation Coal Products Company, Wilmington, Del.

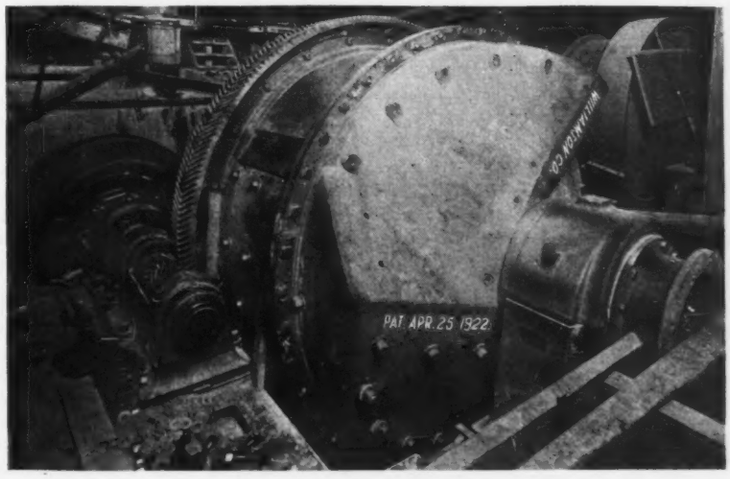
Preparation of ore dust for treatment in a blast furnace, which consists in mixing the dust with coal and then heating and agitating the mixture in a retort to form agglomerates of ore dust and semi-coke.

Erratum

Attention has been drawn to the use of an erroneous local term, in the April 27 issue, to designate the new ball mills being installed by the Miami Copper Company, for which mistake regret is hereby expressed to the Williamson Company, of San Francisco, to whom we are indebted for the following information:

"The Miami Copper Company is installing five 10½-ft. diameter Williamson mills. This fact was mentioned on page 331 of the issue of Feb. 23 and also on page 373 of the issue of March 2. Williamson mills are distinctive in appearance [as indicated by the halftone herewith reproduced].

"In addition, the designation 'Williamson mills,' 'Williamson Company,' and the date of the original patent are cast on the ends of the mills in raised letters."



NEWS OF THE WEEK

Summary

A HEARING on litigation between Nevada Consolidated and Consolidated Coppermines over their adjoining properties in the Ely district of Nevada is expected on May 21. Page 813.

* * *

Noranda is considering the possibilities of increasing its concentrator capacity to 1,500 tons daily, thus permitting higher-grade feed to the smelter and adding to the potential output of that plant, in the Rouyn district. Page 817.

* * *

Centennial No. 2 shaft, at Calumet & Hecla's properties in the Michigan copper district, is being completed to No. 43 level to permit hoisting of material from ground between North Kearsarge and Centennial. Page 816.

* * *

Cerro de Pasco Copper Corporation has an important construction program to cost $15,000,000 under way. An electrolytic zinc plant and a new power plant are included in this program. Page 814.

* * *

Several mines in the Wallapai district of Arizona, including the Golconda and Oro Plata properties, have been merged to form a new company, known as the Copperconda. Page 816.

* * *

American Smelting & Refining has acquired about 1,000 acres of virgin ground adjoining the Silver King Coalition mine, in the Park City district of Utah. Page 815.

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The total cost of additions being made to the New Cornelia concentrator, mine and power plant at Ajo, Ariz., are estimated at about $3,200,000. Page 814.

* * *

Thomas Decker, an American mining engineer, was killed on May 8 at the Cinco Minas property, in Jalisco, Mexico, by two laborers who escaped. Page 817.

Ways and Means Committee to Hear Pleas for Higher Duties on Non-Metallics

By PAUL WOOTON
Special Washington Correspondent

SOME members of Congress are expressing dissatisfaction over the failure of the Ways and Means Committee to accord more tariff protection through the metals and minerals schedules. Further efforts will be made toward rate increases, especially on behalf of non-metallic mining interests. The only question is whether the main line of attack will come in the House or hold over until the bill reaches the Senate.

As this magazine goes to press, the Ways and Means Committee is holding executive sessions wherein members of the House may present their tariff views. Some amendments to the tariff bill will probably be drafted by the committee as a result of these hearings. The mining industry will be well represented, particularly by Southern delegates, interested in promoting the growing mineral development throughout the South.

Representative Jonas, of North Carolina, will speak for mica, monazite, barytes, feldspar, and kaolin. Representative Dickinson, of Iowa, will come to the aid of the independent gypsum producers. Several other members of the House have announced their intention to plead for higher mineral duties.

The Texas delegation is interested in graphite. In the bill, the rates were lowered on flake graphite and slightly raised on other types, it being felt that the existing rates favored Ceylon and discriminated against Madagascar. There is some sentiment that increases should be made throughout the graphite paragraph and that the adjustment between foreign competitors can still be made under higher duties. The American Mining Congress has announced its intention to give continued support to the Southern mining interests.

Offering additional facts toward a higher rate on manganese, the American Manganese Association points out that the duty it is asking will not cause a higher price than the steel producers have been paying over the last five years. During this period, steel manufacturers have been paying an average of 67.7c. per unit, f.o.b. Pittsburgh, for imported manganese, it is pointed out, whereas the highest price offered to domestic producers has been 60c. Foreign interests have more recently made a price drop to 60c. If the same differential reacts against the domestic industry, involving a drop to 52.4c., American manganese producers would be wiped out of existence, it is declared. A rate increase from 1c. per pound to 1½c. is asked for the industry.

Mica received no duty increase, but the wording of the bill has been strengthened so that scrap mica pays 20 per cent and manufactured pays 40 per cent, as intended in the Fordney-McCumber Act. Scrap and waste mica have been imported under a blanket paragraph at 10 per cent and manufactured mica items as "parts of machines" at 30 per cent. The latter evasion is further prevented by limiting the "parts of machines" provision to those wholly or in chief value of metal.

Imported lead or other non-ferrous metals used in the manufacture of export goods are subject to less stringent drawback requirements under the new administrative provisions. At present, the same metal that is imported has to go into export goods if a drawback of duty is to be received. Within a year after the receipt of foreign lead a manufacturer can ask for a refund not to exceed 99 per cent of the duty on the quantity of imported metal which he exports as manufactured wares. Under the proposed arrangement, the imported metal need not actually go into the export manufactures, but an equivalent quantity of domestic lead can be used and the drawback collected as formerly. This eliminates the necessity of treating export goods in separate operations and of earmarking ingots.

Sodium and potassium are specifically named in the chemical schedule at 25 per cent ad valorem.

Kennedy Expected to Start Milling on May 15

Milling operations were expected to be resumed at the Kennedy gold mine, near Jackson, Calif., by May 15, for the first time since the fire which destroyed the headframe last September. Stoping has been started underground, and the ore chutes are being filled. Completion of the skip dump at the headframe is the most important work that remains to be done.

Nevada and Coppermines in Suit Over Mining of Adjoining Claims at Ely

A SHORT time ago Nevada Consolidated Copper sued Consolidated Coppermines in the federal court of Nevada, and the latter company has just filed an answer to this suit. The court has set May 21 for the hearing of Nevada's application for an injunction to prevent Coppermines from starting underground mining. The hearing will be at Carson City, Nev. The suit arose out of differences between the two companies as to the true meaning of a contract providing for the mining by each of some of the outlying boundary ores of the other. In brief, the claims of the companies are as follows:

Nevada and Coppermines both own copper properties, some of which adjoin each other, in the Ely district of Nevada. As neither had any right to disturb the earth or ores of the other, arrangements were made from time to time to care for extraction of ore from the adjoining claims in a practical way. The contract over which dispute has arisen was the last of these arrangements.

The chief point of dispute is whether the power-shovel open-pit method of mining, which Nevada has employed on the Liberty pit for more than twenty years, is privileged, under the contract, in the contract areas against mining by underground methods. If it is privileged, the question of the extent of time and area to which it may be carried is also in dispute.

Nevada claims that it may continue its shovel mining from the Liberty pit until the cost thereof—which naturally increases with the greater depth of the pit—shall have exceeded the cost of mining by the underground method; that it has the right to extend the westerly end of its mining pit—the area in dispute—as may be necessary to accomplish completely such mining to the utmost limits of economy, and therefore that it may thus mine, and indeed, in some respects, must mine, any ores on the properties involved in the contract that can be mined more cheaply in this manner.

Coppermines claims that Nevada should have stopped all its open-pit mining not later than the fall of 1927, and at a depth in the pit not lower than the tenth level thereof, regardless of the comparative cost of mining as between the two methods. Coppermines also claims a right to mine all Nevada ore from the grass roots downward to any depth, along a plane provided in the contract, and in doing so to disregard entirely the western end of the Liberty pit. Coppermines further asserts a right to take any ore on the Nevada side of that contract plane that it may get by drag under the influence of mining, and that, until this work is completed, Nevada must keep away from the territory in dispute.

Nevada claims that Coppermines should so conduct its operations as to avoid imperilling Nevada's pit or the mining operations therein. In addition, it claims that Coppermines is entitled to mine only those ores, west of the contract plane, that are not minable from the pit, and that it (Nevada) has the right to do anything east of the contract plane at any time that will not disturb Coppermines' rights to the west. It defines drag ore as only such as would naturally fall or slide into the proper workings of Coppermines west of and up to the contract plane.

Nevada also asserts that Coppermines can and should avoid any work that may imperil its new Wedge shaft, which was sunk for the purpose of underground extraction of ores not minable by shovels. Coppermines denies any obligation to avoid injuring this shaft, asserting that it has become useless and will have to be abandoned, and refers in this connection to the commencement by Nevada of the Monitor shaft. In its counterclaims, in addition, Coppermines has asked for damages amounting to $500,000 and interest on account of the failure of Nevada to mine ore from the Ora and Emma Nevada claims near the Wedge shaft, above the tenth level, at the minimum rate of 666 tons daily since June 23, 1928. In its claims, Nevada asked an injunction to prevent Coppermines from mining ore within a certain area near the shaft. Coppermines points out that Nevada will have to use open-pit mining on the Liberty orebodies because of the virtual abandonment of the Wedge shaft, and that Nevada has refused to use the Emma-Nevada shaft, sunk by Coppermines, which is fully completed and equipped.

Nevada denies all this, says that it has no purpose of abandoning the Wedge shaft, and in addition asserts that it was always its intention to sink two shafts for its underground mining when it should change to that method on account of the large tonnages to be hoisted; and that this intention was disclosed in January, 1926, long before the making of this contract.

By the present suit Nevada seeks to compel Coppermines to desist from mining from any portion of either the Champion or Liberty claims any ore underlying any part of the Liberty pit until after Nevada's shovel-mining operations in that part shall be completed down to the final pit bottom. It also wants to prevent Coppermines from doing any mining on these claims which will result in injury to or destruction of any portion of Liberty pit, as long as the pit is used by Nevada for shovel mining.

Coppermines seeks to prevent Nevada from mining by shovels any ore which lies west of the contract plane in the Champion or Liberty claims or that which lies east of that plane and would naturally be drawn into it by mining. It also seeks to prevent Nevada from obtaining its injunction or from hindering in any way development work into the Liberty and Champion claims and extraction of ore from these properties. It also claims that Nevada has been trespassing on the Watson claim and holds that it is entitled to damages for ore taken from the Watson claims between March 21 and March 29. Some claims are also made in regard to the allocation of the cost of sinking the Emma-Nevada shaft.

There is also some dispute over domestic water supply, which Coppermines claims it should obtain from Nevada. Nevada says that no contract obligation to furnish this water exists, but that it has always allowed Coppermines any surplus over its own needs whenever available. The parties have not been able to agree on terms respecting the furnishing of water, and so Nevada has asked Coppermines to develop it own supply, allowing it six months in which to do so.

President Hoover Heads Committee to Honor Edison

PRESIDENT Herbert Hoover has accepted honorary chairmanship and will head the general committee for the international and national celebration of Light's Golden Jubilee, according to an announcement at a luncheon given recently by Paul D. Cravath at the Bankers' Club, New York. President Hoover's message read: "I have your kind letter of March 30th requesting that I accept honorary chairmanship of the sponsorship committee of the Edison Pioneers. I shall be delighted to act in any capacity that will mean a genuine tribute to Mr. Edison's services."

The celebration, commemorating the fiftieth anniversary of the perfection of the incandescent lamp by Thomas Alva Edison, will be inaugurated by a series of light festivals beginning at Atlantic City, N. J., on May 31.

Fails to Close Deal for Russian Aluminum Plant

NEGOTIATIONS that have been carried on during the last two years between Dr. Robert J. Anderson and the Soviet government relative to construction of an aluminum-reduction plant in Russia have come to an end. The parties to the negotiations were unable to agree to terms and details of carrying out the project.

Plans called for the design and erection of a plant to produce about 10,000 tons of aluminum per annum, together with an alumina plant and carbon-electrode factory. Power was to be supplied from the Dnieperstroy hydro-electric plant, now under construction. Russian bauxite was to be used as the ore. A special process had been developed to treat this bauxite for the preparation of alumina. Plans were also in hand for the design and erection of rolling mills and other plants for the fabrication of aluminum and its alloys.

A. S. & R. Settles With Carson in Smelter Suit

WILLIAM LOEB, vice-president of American Smelting & Refining, announced recently that a complete compromise settlement has been reached between his company and the Carson Investment Company, owners of the patents issued years ago to George Carson for feeding copper-smelting furnaces. Settlements for infringement of the Carson patents have already been made by several companies, including Phelps Dodge and Calumet & Arizona. The consideration was not announced, but it is known to be large.

Golconda Shipments Make New Record for the Mine

SHIPMENTS of concentrate from the Golconda Lead mill, in the Coeur d'Alene district of Idaho, made a new record for the mine in April. Twelve carloads of lead concentrate were shipped to the East Helena smelter of American Smelting & Refining and thirteen carloads of zinc concentrate went to the Anaconda electrolytic zinc plant. The mill is now handling about 210 tons daily.

Development of the vein on the 1,400 level—the lowest in the mine—has continued very satisfactorily. It averages between 9 and 10 ft. wide and has been proved for a length of 320 ft. by drifting. In the east drift the face shows the shoot to be 12 ft. wide, with about 2 ft. of high-grade lead-zinc ore in the middle.

A crosscut is being driven on this level south to the Klondike vein in the Mayflower ground, recently acquired by Golconda. On the 1,000 level the Klondike vein was nearly vertical, but evidently the dip changes to the south, as the crosscut has passed a point vertically beneath the one where it was encountered on the 1,000 level without finding the vein.

Nipissing Mines, the Canadian company which was recently conducting negotiations with Jack Waite, also in the Coeur d'Alene district, recently examined the Golconda, and it is understood that negotiations for sale of the property are now under way. The company is capitalized at 2,000,000 shares, and Nipissing is said to be willing to offer $2 per share.

Tantalite Found in North Australia

The Director of Mines of the Northern Territory of Australia, at Darwin, recently announced the receipt of a sample of tantalite mined at Griesen Dyke, West Arm, assaying 73 per cent tantalic acid, said to be the best quality of tantalite ever found in Australia. That continent has been a source of a part of the world's supply of this rare mineral for many years, but it has been found only in remote regions, and the deposits have not been exploited on any large scale. The extent of the new deposit in northern Australia is unknown.

Cerro de Pasco Will Build New Power Plant and Electrolytic Zinc Unit

AN EXTENSIVE construction program, which will cost $15,000,000 and take from three to four years to complete, is being undertaken by Cerro de Pasco Copper Corporation at its properties in Peru, according to E. H. Clark, president of the company, in a statement made at the annual meeting of the company in New York City.

Probably the most important feature of the new construction program is the decision of the company to begin production of metallic zinc. Cerro already produces copper and lead bullion from smelters at its properties. An electrolytic zinc plant will be built at Oroya to handle the output of two new zinc concentrators, one of 1,000-ton daily capacity and the other of 600-ton capacity. Zinc concentrate has been shipped to Europe for treatment heretofore.

The company is also constructing a new hydro-electric power plant on the Montaro River, to furnish 35,000 hp. This installation will cost $6,500,000. Last year, operations at Cerro de Pasco had to be curtailed because of the lack of power during the Peruvian dry season, and construction of this new unit has undoubtedly been undertaken to obviate such difficulties in the future.

Driving of the Mahr tunnel, 30,000 ft. long, will continue for three or four years. This tunnel will drain the Morococha mines to a depth of 1,650 ft., which is about 650 ft. below the present deepest workings. A. Guthrie & Company, which drove the Cascade tunnel, will act as consulting engineers and will supervise the work, furnishing superintendents and men.

A tramway and a small mining plant will be installed at the Yauricocha mines for further development there, and an office building will be constructed in Lima, the capital of Peru. Production of the company during 1928 was 97,769,279 lb. of copper, 29,380,000 lb. of lead, 20,000,000 lb. of zinc, 16,383,847 oz. of silver, and 26,013 oz. of gold. All directors were re-elected.

Burwash to Lead Party Into Coppermine Area

DURING the coming summer an investigation of the mineral and other natural resources of the Coppermine River mineral reserve on the Canadian Arctic coast will be undertaken by Major L. T. Burwash, exploratory engineer of the Northwest Territories and Yukon Branch of the Department of the Interior. The area contained in the reserve is described as being that portion of the Northwest Territories lying north of the 65th parallel of North latitude, and between the 105th and 116th degrees of West longitude, comprising the islands in and the territory adjacent to Coronation Gulf and to Bathurst Inlet.

For many years the existence of deposits of native copper along the Arctic coast of Canada has been known. The names Coppermine River and Yellowknife Indians (the latter so named because they made knives and utensils from the metal) bear testimony to the early knowledge of these deposits. Thirty years ago the idea prevailed in many quarters that large deposits of almost pure copper were to be found in the area and that its recovery was impracticable only because of the inaccessibility of the territory. Later, during the war, the high price of copper set men thinking of these reported rich deposits, and interest in them revived. In the meantime the Dominion government had the area examined and has, through the Geological Survey of the Department of Mines, been informed that though pieces of drift copper are occasionally found and though it seems highly probable that parts of the district contain workable or even rich deposits, the area as a whole is one which to be profitably worked must be developed on a large scale.

Additions at New Cornelia Will Cost $3,200,000

ADDITIONS to equipment at the New Cornelia mine, recently taken over by Calumet & Arizona in the merger of that company with New Cornelia Copper, will cost a total of $3,200,000, according to reports. The concentrator at Ajo is being increased from five sections to eight, with a consequent increase in capacity to 15,000 tons daily. The present capacity of the concentrator is 10,000 tons and of the leaching plant 5,000 tons. However, exhaustion of the oxidized ore at the mine will lead to dismantling of the latter unit and will consequently necessitate handling the entire output at the concentrator. An additional 7,500-kw. turbine will be added to the power plant, and three new shovels for the open-pit operations will be purchased.

J. K. Vinton, manager of the New Cornelia Co-operative Mercantile Company, announces that for the first quarter of 1929 the store purchased goods worth $113,064 in Arizona, of total purchases of $193,852. Of the amount spent in Arizona, $40,562 represents products of the state.

The Katherine mine and mill, near Kingman

Katherine Gold Reduces Operating Force

Katherine Gold, in the Kingman district of Arizona, has reduced the number of men employed to sixteen. This operating force is being employed entirely in development work on the 300, 400, and 600 levels and in making an assay map of the mine. Operations at the mill have been suspended for a short time, but are expected to be resumed soon.

Liberty Montana Increases Mill Capacity to 150 Tons

According to F. R. Springer, manager of the company, Liberty Montana Mines has increased mill capacity at its plant in the south Boulder Creek district, near Cardwell, Mont. The concentrator, which handles silver-gold-copper ore from the company's Mammoth mine, is now equipped to handle 150 tons daily, as compared with about 60 tons before the additions were made.

Complete Geophysical Survey at Mine Near Nogales

According to H. W. Miller, of Nogales, Ariz., the Radiore Company, of Los Angeles, has completed a geophysical survey of the Picnic property, 7 miles east of Amado, Santa Cruz County, and north of Nogales. Eagle-Picher Lead, which is operating the Montana mine and mill, at Ruby, may explore the Picnic property with diamond drills, according to report.

Mineral Hill Mine Sold

Mineral Hill Consolidated Copper, owning properties near Tucson, Ariz., has been sold at public auction to the Barnsdall Corporation for $200,000. The purchasing company was a creditor of Mineral Hill to the extent of $400,000, in addition to owning a large part of the stock. Operation of the mine will be continued.

Properties of Mineral Hill Consolidated consist of 26 claims, twelve of which are patented, in the San Xavier district, Pima County, 18 miles southwest of Tucson. The mine is said to carry sulphide ore containing 3.5 per cent copper.

Consolidate Mines Near Tucson to Form Twin Buttes

Several mines south of Tucson, Ariz., including the Venus, North Star, King Queen, Glace, Bullion, and Twin Buttes properties, have been consolidated to form the Twin Buttes Copper Company. The operating force at the Twin Butte mine, now consisting of about 50 men, will be increased, and development work will be started on some of the other properties in the group. The company is reported to be considering construction of a 600-ton mill near the Southern Pacific line. George Kennedy and W. C. Laughlin are in charge of the work.

Several Positions Open With Bureau of Mines

The U. S. Civil Service Commission announces open competitive examinations for the positions of senior mining engineer, mining engineer, associate mining engineer, and assistant mining engineer with the U. S. Bureau of Mines. Applications must be on file with the U. S. Civil Service Commission not later than May 29. Further information may be obtained by addressing the commission. An examination for the position of junior metallurgist is also announced. Applications must be made by June 4.

Start Work on Designs for New Howey Mill

General Engineering Company, of Salt Lake City, Utah, has started work on the design of a 500-ton cyanide plant to treat gold ore from the property of Howey Gold Mines, Ltd., in the Red Lake district of Ontaria, Canada. The plant will be designed and constructed by General Engineering Company, as engineers. The designing will be carried out in the company's office at Winnipeg, Manitoba.

Sinking Started at Miami

On May 6, the E. J. Longyear Company, of Duluth, Minn., started sinking the No. 5 shaft of Miami Copper, at Miami, Ariz. The shaft will be lowered from the 1,000 level to the 1,120 level, preparatory to making the former the main haulage level in the mine.

A. S. & R. Acquires Virgin Ground in Park City District

OPTIONS on 1,000 acres of ground in the Park City District of Utah, adjoining Silver King Coalition to the north and east, have been acquired by American Smelting & Refining through its western mining department, from George H. Short, Salt Lake consulting engineer. No work has yet been done on the property. Park City limestone is exposed on the southern portion of the ground and Woodside shale on the north. Preliminary geologic work, perhaps supplemented by diamond drilling, will be started about June 1. Claims included in the groups are the Grasselli Chemical, the Spriggs, the Mills and State land.

Raymond Ely Extension Exploring Property at Pioche

TWO drifts are being run on the 375 level of the Raymond Ely Extension mine, at Pioche, Nev., under the direction of Neil Snyder, superintendent. A drift is being driven north to prospect the projection of the famous Raymond Ely-Meadow Valley ore zone at its intersection with the Combined Metals limestone bed. A West drift is being advanced to prospect the Prince limestone bed at its intersection with fissures showing mineralization in churn-drill holes put down last year.

The Bristol mine, at Pioche, is shipping 175 tons a day and making a profit. A dividend will probably be paid during the current year.

Deepen Lehi Tintic Shaft to 1,100 Level

SINKING of the Lehi Tintic shaft, in the North Tintic district, near Eureka, Utah, from the 750 to the 1,100 level is to be started at once to prospect strong ore showings opened up for 310 ft. on the 960 level of a winze sunk from the 750. Guy W. Crane, Salt Lake City consulting geologist, is to direct exploration work. R. M. Crocker will continue as mining engineer and Charles Zabriskie as superintendent. The shaft is being retimbered from the 650 to the 760 level. Under a co-operative agreement Tintic Empire is also driving a drift southeast from the 750 Lehi Tintic level to open up its ground.

Basin Cataract Opens Vein

Basin Cataract Mining Company, a rehabilitation of the Jib Consolidated Mining Company at Basin, Mont., has opened a 6-ft. vein of gold ore in its East Katie property and has also opened up high-grade material at several spots. Under supervision of W. C. Madge, ore reserves are being blocked out before starting the mill.

Calumet & Hecla Completing Centennial to No. 43 Level

GROUND developed in the long stretch between North Kearsarge and Centennial will be mined through Centennial No. 2 shaft, of Calumet & Hecla, in Michigan. To make this possible, the No. 43 level drift now is being holed through to the bottom of the Centennial. The shaft then will be completed to the No. 43 level. Grade is particularly good near the Centennial area, just north of the line of No. 2 shaft. South of Centennial, a long stretch on the Kearsarge lode offers possibilities. It was not opened to any extent by the old Centennial company.

The crosscut east from the No. 78 level of No. 12 South Hecla shaft of Calumet & Hecla will cut the Osceola lode in a zone of which little is known on account of the great depth. This is the first opportunity to explore the bed in its deeper reaches, approximately 4,000 ft. below the five operating shafts.

New Gold Strike Reported at Grass Valley

A NEW gold strike has been reported in the Grass Valley district of California, on the property of Grass Valley Boundary Mines, which has holdings in the western side of the district. The property is opened by a 350-ft. incline shaft. On the 350 level (227 ft. vertical depth) a crosscut was driven to a parallel vein and a drift extended on this vein. At a point where oxidized material showed, a raise was started, and 50 ft. above the level a rich shoot of free gold ore is said to have been struck. The quartz is stained with iron oxide and contains a large proportion of free gold.

The ore resulting from the round was placed in powder boxes and taken to Grass Valley, where it was freely exhibited. Further work has been discontinued, and the extent of the pocket or shoot is therefore unknown. Other strikes of rich ore have been reported in the western part of the district, but no important quantity of high-grade ore has been worked for any length of time.

Increase Capacity at Michigan Smelter in Houghton

Improvements under way in the Michigan smelter in Houghton, Mich., will bring about an increase in efficiency and capacity. Considerable work remains to be done, but good progress has been made with the various changes and repairs. The principal item is the reconstruction of No. 3 melting furnace, together with its waste heat boiler. The entire bottom of No. 2 casting furnace also has been rebuilt. With completion of the improvements, capacity can be increased 20 per cent if needed. Michigan treats the mineral of the Copper Range, Mohawk, and Isle Royale mines.

Construct 15-Mile Flume Near Helena, Calif.

NORTH PLACERS, operating near Helena, Trinity County, Calif., has completed 10 miles of flume out of 15 miles which will be built to connect its property to the North Fork of the Trinity River. About 40 men are employed in constructing the 40x32-in. flume. Some hydraulicking is under way, but completion of the flume is necessary for full operation.

To Deepen New Lake Shore Shaft to 2,000 Ft.

LAKE SHORE is cutting a station at 1,800 ft. in its new shaft at Kirkland Lake, Ont., and when this work is completed the company will continue sinking the shaft to 2,000 ft. When the lower level is reached, crosscuts will be driven under the old shaft, and a raise put up to connect with it. Diamond drilling and development work done to date indicate that the No. 2 vein contains more ore between the 1,000 and 1,800 levels than in the upper workings. Widths of 40 to 50 ft. have been found in several places.

Preparations are now being made for the enlargement of the Lake Shore mill to 2,000 tons daily. This work will not be completed until December, but the management hopes to have the mill handling 1,500 tons daily by the middle of the summer.

Sylvanite Cuts 6-Ft. Vein on Its 2,000 Level

ON a crosscut, 625 ft. west of the shaft, on the 2,000 level of the Sylvanite mine, at Kirkland Lake, Ont., a 6-ft. vein has been cut which shows high-grade ore. This is believed to be one of the main veins encountered in the upper levels, but so far as development has progressed it appears to be richer on the 2,000 level. Diamond drilling has also located the extension of the ore west of the fault on the 500 level, and preparations are being made to open up this section of the mine.

Results of the development program for the next few months will be very important in determining the success of this enterprise. Present indications point to an increase in mill capacity, now 200 tons.

Iron and Steel Men Will Meet in New York May 24

On May 24 the American Iron and Steel Institute will hold its thirty-fifth general meeting at the Hotel Commodore, New York City. Technical papers will be read at the morning and afternoon sessions and the annual banquet will be held in the evening.

Wallapai District Mines Taken Over by Copperconda

A NEW company, known as the Copperconda, has taken over the Golconda and Oro Plata mines, in the Wallapai district, Mohave County, Ariz. Several other near-by properties are being included in the consolidation. To facilitate operation, the Peach tunnel will be driven 2,200 ft. to intersect the Golconda shaft at the 1,000 level. The company expects to strike the Prosperity, Primrose, Big Silver, and Tubb veins, containing silver-gold-zinc ore, in driving this tunnel.

During the war, the Golconda mine, which consists of 30 claims and a mill site, shipped zinc ore steadily. Total production is estimated at more than 15,000,000 lb. A 100-ton flotation mill has been built, but it will not be operated by Copperconda until the present development program is completed. The Oro Plata mine was operated by Golconda Extension, and it consists of nine claims. This property had been idle for several years, but was credited with a production of $500,000 up to 1916.

Leasers Making Shipments From Old Horn Silver Mine

SHIPMENTS are being made from the Horn Silver mine, operated by Tintic Lead, at Frisco, Beaver County, Utah. Mining on a leasing basis is under way on the 500, 600, 700, and 900 levels. The company is doing development on its own account on the 1,000 and other levels. Phillip Clark, Eureka mine operator, is in charge of leasing.

A new twelve-drill compressor, a carload of mine cars, a carload of powder, and three General Electric 44,000-volt, 125 kva. transformers have arrived at the property. Telephones, electric lights, and electric bell signals have been installed on every level.

Erratum

In the issue of May 4, on p. 731, the statement was made that the Abana mine had been allowed to fill with water because of lack of funds. Our attention has been called to the fact that this action was taken not because of lack of funds but because all the available power was needed to complete the surface construction program. The error is regretted.

Democrat Mines to Ship

A shipment of gold-silver-lead ore will be sent to Phelps Dodge lead smelter, at Douglas, Ariz., from the property of Democrat Mines, operating in the Kingman district, Arizona, about May 20. Operations at this property were started by Canadian interests about six months ago. A road has been built to the property and shaft sinking has been carried on. Recently a new vein, 12 ft. wide, was struck.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Noranda May Enlarge Mill—Official Statement Made on McIntyre-Porcupine

TORONTO, May 11, 1929.—Noranda Mines is considering the possibility of enlarging its concentrator at Rouyn, Quebec, for the purpose of concentrating some of the medium-grade ore that is being sent direct to its smelter. As recently reported in *Engineering and Mining Journal*, underground developments have been such that when the additions being made to the smelter at present are completed, in September, officials may be faced with the necessity of providing still greater facilities. This difficulty may be solved by enlarging the concentrator capacity to 1,500 tons daily, however, and producing a high-grade copper concentrate. By using this concentrate in the smelter, instead of some of the present direct-smelting ore, which averages 8 per cent copper, a greater output can be obtained without enlarging smelter capacity. A. W. Fahrenwald, of the U. S. Bureau of Mines, at Moscow, Idaho, will spend three or four months at Noranda on this problem and also on the possibilities of selective flotation of copper-zinc ores.

PRELIMINARY to the issuing of the annual report, an official statement has been made on the McIntyre-Porcupine mine, of Porcupine. Rumors have been current to the effect that developments on the lower level of McIntyre are not as favorable as had been expected. However, the company states that the geological formation on the 3,875 level is as good as on the levels above. The area of basic schist is just as favorable to gold deposition as anywhere in the mine, and so far as ore disclosures go, results on the 3,875 level equal those secured on the best upper levels of the mine at the same stage of development. Four new veins other than the ones originally intersected by the main crosscut have been located at 3,875 ft. Veins Nos. 13 and 14 have been partly developed in the vicinity of No. 11 shaft from 1,625 to 3,875 ft. Already production from these veins, comparable with that from veins 5 and 7, which up to this time have been McIntyre's most important producers, seems likely.

Earnings for the fiscal year were substantially above those of the previous year, and the estimate of ore reserves is in excess of $16,000,000. As a result of the use of the cut-and-fill method of stoping in the mine, very little broken ore is on hand. This method is providing clean ore with a minimum of dilution, and costs are proving better than had been anticipated. An early decision with regard to mill expansion is not expected. At present ore reserves are equal to more than four years' supply at the current rate of production, but the directors are of the opinion that more than this is required before the mill is enlarged.

The country in the vicinity of the Hudson Bay Railway, of northern Manitoba, recently suffered from one of the worst blizzards in its history. About 200 men working on railroad construction are marooned north of Mile 460, on the Hudson Bay Railway, and supplies of food on the work trains are believed to be nearly exhausted. Attempts were made to send food from a cache near Mile 460, but horse and dog teams failed to get through. Three large tractors are now en route to the stranded crews, but it will take them several days to break through, as the roadbed is choked with hard-packed drifts for a stretch of 65 miles. Two trains are stalled in the snow, but no fears are expressed for the men, because if the worst comes to the worst, airplanes are available and can be used.

The annual report of Abana Mines, in Quebec, has just been mailed to shareholders and is accompanied by a supplementary report giving results until April 30. Assays and tonnage estimates had not been completed at the time of mailing of the report, but will be available for the annual meeting on May 27. Most estimates place the total between 250,000 and 300,000 tons of ore. The management is quite emphatic on the point that the mine is not yet ready for a mill and that in any event the present two-compartment shaft is not large enough to hoist ore and carry on development work at the same time. In the meantime, however, milling tests will be made and mill designs checked up. By the time Nos. 4 and 5 levels are developed, together with diamond drilling under No. 5 level, sufficient information should be on hand to settle the policy with regard to the mill. This work will probably be completed by next November.

Moscow Silver Starts to Sink Shaft from 1,400 Ft.

SINKING of the Moscow Silver Mines shaft, situated in the Star district, nine miles from Milford, Utah, is to be begun at once. The shaft will be deepened from the 1,400 level to the 1,500 level or lower. Cable sufficient to reach the 2,000 level has been ordered.

Drifting on the 1,100 level, south, to cut orebodies productive of high-grade ore near the surface, has been started. A contract for this work and sinking of the shaft has been awarded by Garratt S. Wilkin, manager of the company.

On the 1,550 and the 1,565 level, drifts to the southwest have opened up oreshoots, 6 and 8 ft. wide, respectively. A carload of ore shipped from the 1,565 level netted the company $2,200, after deductions had been made for smelter and railroad charges.

Mexico City Letter

BY W. L. VAIL
Special Correspondent

Engineer Is Killed at Cinco Minas—Agreement on Gold Exports Ends

MEXICO CITY, May 10, 1929.—Federal authorities are making strenuous efforts to locate the murderers of Thomas J. Decker, American engineer at the Cinco Minas properties, at Magdalena, State of Jalisco, who was killed on May 8. Mr. Decker was attacked by two workmen, while in his laboratory, and was literally hacked to pieces. He was buried in Guadalajara. He leaves a wife and two children, who were in the United States at the time of the murder. A band of rebels recently robbed the mine, and it is believed that several of the laborers are in league with the bandits. Both of Mr. Decker's assailants escaped. Cinco Minas is owned by private interests, headed by James W. Gerard.

THE temporary decree, made last October, which relieved exporters of metals from the obligation to re-import gold bars equivalent to the gold content of exported ores or concentrates was suspended on May 1. From that date, all exporters must reship into Mexico in the form of gold bullion or foreign gold the equivalent exported in ores, and a bond will be exacted to insure compliance with regulation. Evidently the Department of Finance believes that the conditions which caused the suspension have passed.

Work on the San Cristobal mine, undertaken by California interests, has been abandoned, according to reports from Acapulco, Guerrero. The property was recently optioned and unwatered for exploration work. Preliminary surveys are being made by engineers for a railroad from Acapulco to the old Dicha copper properties. Work at these properties was suspended during the early days of the Madero revolution in 1910. E. D. Elson, who was formerly associated with attempts to develop the Dichas mine, is representing the interested parties. At one time a concession was granted for construction of a railroad from the Balsas River to Acapulco which would have crossed the property, but no work was done.

Nevada Tungsten Plant to Resume Operations

The enlarged mill of the Tungsten Products Company, in the Nightingale district, 50 miles west of Lovelock, Nev., is to start immediately. The mill has been remodeled and increased to a capacity of 250 tons daily. Thirty men will be employed. Development carried on in the last year has augmented the water supply.

MARKET AND FINANCIAL NEWS

Nevada Con. 1928 Net Income Up $9,457,374

NET INCOME, before depletion, of Nevada Consolidated Copper Company, totaled $15,201,103 in 1928, compared with $5,743,729 in 1927 and $6,832,395 in 1926. The cost of producing copper, before federal income taxes but including all other taxes and all general expenses and accounting charges for depreciation of plant and equipment, and after crediting the value of gold and silver and miscellaneous earnings, was 8.78c. per pound, compared with 10.03c. per pound for 1927.

Total charges to capital account during the year amounted to $1,337,926. These represented chiefly development and the installation of equipment in preparation for mining by underground methods the deep-lying ores below or adjoining open-pit areas at Nevada and Chino mines and in the improvement of metallurgical facilities both as to capacity and efficiency.

Nevada Con. Production Data

	1928	1927
Copper, lb.	268,462,629	218,683,930
Silver, oz.	256,647	210,350
Gold, oz.	61,890	43,052

Statement of Operations for 1928

Operating revenue:		
Copper, gold and silver produced		$41,891,067
Operating expenses:		
Mining, including stripping and development charge	$9,958,820	
Ore delivery, mine to mill	1,567,746	
Milling	5,950,663	
Treatment, freight and refining	6,875,504	
Selling commission	335,526	24,688,262
Profit from operations		$17,202,805
Miscellaneous income, net		1,368,755
Total income		$18,571,561
Charges against income:		
Depreciation	$1,676,647	
Plant and equipment retirements	149,398	
Federal income tax and other charges	1,379,812	3,205,858
Net income before interest		$15,365,702
Interest on debentures		164,598
Net income to surplus account		$15,201,103

Surplus From Operations

Balance Dec. 31, 1927		$12,574,943
Net income for year (before depletion)		15,201,103
		$27,776,047
Charges against surplus for taxes of prior years	$13,168	
Distributions to shareholders	7,892,684	7,905,852
Balance Dec. 31, 1928		$19,870,194

The mines and plants have demonstrated great elasticity in their response to demands for increased output. Equally noteworthy is the record of declining costs, which has continued over a period of about three years, regardless of production volume.

Though ore reserves were not recalculated at any of the properties, it is definitely known that the ore tonnage available is much larger than that recorded, and this will become increasingly true as declining costs, in company with higher prices for copper, permit profitable treatment of lower grade material.

At Chino approximately 25 per cent of the ore mined from the shovel pit came from areas lying outside the previously known and measurable orebody, and undoubtedly additional tonnages of the same nature will be encountered in future years as the pit area is extended. To insure the maintenance of a steady output from underground sources as shovel production declines at the Nevada mines, and thereafter when pit operations may have been discontinued, the company engineers have decided to sink immediately, rather than later, a second shaft, which will accommodate the mining of the Copper Flat orebodies by underground methods. This will be on the Monitor Claim some 1,500 ft. north of the present Wedge shaft. At present some surface work is being done in preparing the shaft site, and actual sinking will start in the near future.

The application of improved and lower cost methods of mining at Ray was extended wherever practicable during 1928, and the operation of the revised system found to be satisfactory in every respect. Besides making possible an increased output from No. 2 shaft, this method also permitted production to be concentrated into more limited areas than had heretofore been possible, which improved underground conditions materially, minimized the number of active blocks required, and rendered it unnecessary to secure any output from the fourth level. The application of this system has resulted in a material decrease in the cost of mining, and has also demonstrated that it can be used successfully in virtually any class of ground except that which is unusually weak and friable.

At Chino mines the shaft to serve the mining operations for the orebodies to be mined by underground methods was sunk to a total depth of 661 ft. to the main haulage level. The concreting of this shaft is now in progress. No actual production of ore from underground sources will be required for the next two years, as the shovel pit is in condition to provide the full capacity requirements of the concentrator.

At Nevada mines the cost of steam-shovel mining, exclusive of depreciation and all local, state, and federal taxes, but including all other overhead expense of every nature, was 22.38c. per ton, and the cost of stripping overburden was 57.10c. per cubic yard. The cost of mining underground ores from the Ruth mine was $1.016 per ton. At Ray the total underground mining cost of the year's production, exclusive of depreciation and taxes but including all other expenses, was 68.83c. per ton. At Chino, where all ores were mined by power shovels, the cost for the year, exclusive of depreciation and taxes, but including all other expenses of every nature, was 32.22c. per ton. The cost of stripping at Chino for the year was 51.98c. per cubic yard. Mining costs stated above do not include the usual charges made at all mines against each ton of ore produced to cover prepaid development or stripping expense or both. This charge for the year was, at Nevada mines, 40c. per ton; at Ray 15c. per ton; and at Chino 45c. per ton.

At Nevada mines the most important improvement at the McGill concentrator was the installation of bowl classifiers to deslime the product from the coarse-crushing department before it was fed to the fine-grinding ball mills. In the coarse-crushing department two cone-type crushers are now being substituted for the two gyratories and additional screening facilities are being provided. When both of these improvements are completed the McGill concentrator will have an economic capacity of 18,000 tons a day, with finer grinding that was previously secured when treating 15,000 tons a day. At Ray no alterations of major importance were made to the Hayden concentrator during the year, although very material reduction in the cost of milling was effected through minor revisions in the fine-grinding circuit and alterations in the flotation flow sheet, which were accomplished without the installation of any additional equipment and at small cost. When completed, the Hayden concentrator will have a capacity of 12,000 tons a day.

At Chino, the Hurley concentrator is being improved, and its capacity when these betterments are completed will be about 15,000 tons a day. At all divisions the grade of concentrates was improved over that previously produced, resulting in noteworthy economies in the cost of

smelting. Work conducted both in the laboratories and in the plants themselves on operating scale tonnages has pointed out the way for effecting further economies in the cost of milling, with equal or better metallurgical performance, though these benefits will not be fully secured until the completion of the improvements now in progress.

At Nevada mines the increased production for the year necessitated the operation of two reverberatory furnaces a large part of the time. Recovery of copper in reverberatory smelting for 1928 was 97.62 per cent, compared with 97.18 per cent in 1927. The tonnage per furnace day was somewhat lower than in the previous year, but the net fuel ratio, in terms of powdered coal per ton of charge, was the lowest ever attained, being 4.7 for the year, as compared with 4.9 for the previous year. To minimize dust losses, a Cottrell precipitating plant, which will be located close to the roasters, will be constructed. It was also planned to erect a new stack at the same location, to promote better operating conditions and to avoid extensive repairs and heavy maintenance charges to the present roaster stack and long connecting flue. The average grade of all company material milled was 1.363 per cent copper, and the average recovery in the form of concentrates was 86.56 per cent of the total copper content, compared with a grade 1.326 per cent, and a recovery of 87.9 per cent, in 1927.

At Nevada mines, a 7,500-kw. turbo-generator has been ordered and will be installed in the McGill power plant to provide sufficient power to operate the concentrator and smelter at full capacity of 18,000 tons of ore daily. At the Ruth mine, an additional supply of water for domestic and other purposes is being provided for by the installation of a pumping system, which will take its supply from Murry Creek, a permanent source of water. No expenditures were made for major improvements during the year at Ray. At Chino, the installation of a 7,500-kw. turbo-generator set and its auxiliaries was completed, this unit being put into operation in September, and some work is being done in the boiler plant to equip the boilers for burning pulverized coal. At the Santa Rita pit, the operation of the power shovels is being changed from steam to electric power. Additional and improved accommodations are being provided for employees of this division.

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ARIZONA COPPER COMPANY, LTD., at its extraordinary general meeting held April 25, 1929, confirmed the resolution passed on April 10 for the winding up of the company and the appointment of William Rintoul its secretary, as liquidator. The directors were appointed as a committee to advise and consult with the liquidator. A resolution to vote to the directors the sum of £10,000 for special services in connection with the sale of the shares of Phelps Dodge Corporation was also passed.

Magma Shared in 1928 Copper Prosperity

EARNINGS of Magma Copper Company for 1928 totaled $1,925,495, compared with $825,044 in 1927 and $1,210,520 in 1926, reflecting an improvement noted by most copper producers during the year. The 1928 financial statement follows:

Consolidated Surplus Account

Balance Jan. 1, 1928		$350,721
Net gain for 1928	$1,952,495	
Unclaimed wages and miscellaneous	581	1,953,076
		$2,303,797
Obsolescence	$1,948	
Loss on sale of property	183,011	184,960
		$2,118,836
Dividends declared in 1928		1,326,503
Balance Dec. 31, 1928		$792,332

The No. 2 shaft, which was damaged by fire last year, has been cleaned out and repaired. It was necessary to retimber this shaft from the 1,400 level to a point 75 ft. below the 2,550 level. The ground around this shaft is in bad condition, and the shaft is being concreted. When the concrete work is finished, sinking will be resumed in this shaft.

A connection was made between the mine and No. 5 shaft on the 2,000 level. Considerable development work was done from No. 5 shaft on this level. This work disclosed several fissures, one of which may be the Magma vein, but none of these fissures contained ore. Drifting was also done on the 2,250 level from No. 5 shaft. A vein was encountered in No. 4 crosscut north that showed good ore. The vein was drifted on to the west for about 40 ft., when a fault was encountered that threw the vein to the south. The main drift was continued west, and a crosscut south was driven. The vein was crosscut in this crosscut and was found to be 16 ft. wide, and 11.6 ft. of this was ore.

It has been decided to sink a new shaft to be known as No. 6 shaft to connect the east section with the surface. This shaft will be started from a point approximately 4,500 ft. east of No. 3 shaft. Work was started on a tunnel that will be driven to the location of the shaft, and from this location the shaft will be raised to the surface and sunk to the 2,550 level. Stoping operations were carried on satisfactorily during the year. Ore was mined from between the 1,800 and the 2,550 levels and was of a somewhat higher grade than the material produced in the last few years.

Concentrator operations were continuous during the year. It was not necessary to run the three sections of the concentrator full time to mill the tonnage produced by the mine. Mill heads for the year assayed 6.52 per cent copper. The tailing average was 0.18 per cent copper. The average extraction was 98.38 per cent.

Smelter operations were carried on in a satisfactory manner. A 4-ft. Symon's Cone Crusher was installed in the mill to replace the disk crushers which have been in operation there. This cone crusher has greater capacity and gives a better product for the ball mills than the machines it replaced. To provide against any curtailment of production as a result of power shortage, the company's power plant will be enlarged. The 3-R Mine, at Patagonia, which the Magma Copper Company owned for several years, has been sold.

Magma Copper Company Production Data

	Copper, Pounds	Silver, Ounces	Gold Ounces
Magma mine output	35,228,810	917,048	8,665
Custom ores purchased	1,229,319	193,319	3,114
Total production	36,458,129	1,110,367	11,779

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DOLORES ESPERANZA CORPORATION reports profit of $149,210 in 1928 before allowing for depletion or depreciation. The Dolores mine is being closed down permanently, as the known orebodies have been completely worked out. The company's Concheno property, at Concheno, Chihuahua, was treating about 3,000 tons of ore per day early in February, at the time the report was written. The La Dura property was operated without interruption in 1928 for the first time since 1911. Railroad service was considerably improved.

Magma Consolidated Income and Expense Statement for 1928

Sales of copper			$4,692,719
Cost of sales:			
Inventory of metals, ores and concentrates, Jan. 1, 1928		$1,191,044	
Operating expenses	$3,505,814		
Depreciation	404,921		
State and county taxes	303,477		
	$4,214,213		
Gold and silver sales	801,152	3,413,060	
		$4,604,104	
Inventory of metals, ores and concentrates, Dec. 31, 1928		2,009,947	2,594,156
			$2,098,562
General, administrative and engineering expenses			90,151
			$2,008,411
Interest and other income			64,298
			64,298
			$2,072,709
Railroad income		$143,322	
Railroad operating expense	$97,431		
Depreciation—roadway and equipment	44,176	141,608	1,713
			$2,074,423
Less estimated reserve for federal income tax			121,928
Net gain for year			$1,952,495

London Financial News

Rio Tinto Taxes Total Huge Sum of £1,400,000

By W. A. Doman,
Special London Correspondent.

FOR MANY YEARS the Rio Tinto Company has been a vast undertaking; and its recent expansion has raised it to the position of one of the most important metal companies in the world. In one way and another it has dealt in big figures, but until Sir Auckland Geddes, the chairman, made his speech at the annual meeting last week, it is to be doubted whether any shareholder had any idea of the real magnitude of Rio Tinto and of its ramifications. The taxation figures alone are astonishing, for not only has the company had to find £638,422 to meet arrears of Spanish taxes, but it has also had to provide £539,235 for Spanish taxes for the year, a total of £1,177,657. In addition, £200,000 has been carried to an emergency account to meet arrears in contingent taxes which are determined by the amount of the export taxes. Of this total over £1,000,000 was found from the income of the year, and the balance was drawn from suspense accounts. Taxes paid in other countries ran into £250,000, raising the total to over £1,400,000.

As a result of quiet markets last year, the General Mining & Finance Corporation showed a substantial falling off in profits from share dealings. In fact, the profit was only £90,293, as compared with £325,187 for 1927. Investments in stocks and shares amount to £1,049,287, and cash and government securities to £452,362; sundry liabilities aggregate £504,894.

The Panama Corporation has obtained an additional concession. The previous concession consisted of 3,775 square miles in Darien and 1,100 square miles in Veraguas. The new concession adjoins the Veraguas and is 2,000 square miles in extent. It is officially stated that the importance of this lies in the fact that the majority of the mining operations now being carried out are in the Veraguas concession and extend right across the Isthmus from the Pacific to the Atlantic.

Amalgamated Mining Trust, one of the Consolidated Goldfields group, earned a net profit for the twelve months to March 31 last of £196,360, against £72,150 in the preceding year. It is rumored that the company, and also Consolidated Goldfields, have sold their holdings in the American Potash & Chemical Corporation. This explains the increase in profits in the Amalgamated Mining balance sheet in a year otherwise devoid of any great interest.

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Consolidated Lead & Zinc Company, operating in the Tri-State district, reports net profit of $69,209 for the year ended Dec. 31, 1928. Dividend disbursements in 1928 totaled $100,000. The company reports that owing to the necessity for curtailment of production, its total cost of ore treated was $1.913 per ton, compared with $1.797 in 1927. The company produced 3,125 tons of lead and 28,423 tons of zinc from 449,557 tons of ore in 1928, as against 5,296 tons of lead and 31,176 tons of zinc from 613,978 tons of ore in 1927.

Chichagof Mines, Ltd., operating the old Chichagof Mine, in Alaska, with head office at Vancouver, B. C., held its annual meeting March 15. The report submitted showed the following new development: Drifting and crosscutting, 1,666 ft.; sinking, 71 ft.; raising, 158 ft. The work consisted in extending the main crosscut to develop the several shear zones, four of which have been intersected. Drifting and sinking were also done on No. 3, where ore of similar character and metal content to that mined in the old days in No. 1 has been found, though the shoot is narrow. New reserves valued at $30,000 have been developed in No. 1. A subsidiary company, known as the Chichagof Power Company, was organized with an authorized capital of $100,000 to take over and operate the power plant to supply power for the Chichagof Mines as well as for the Hirst-Chichagof Mining Company, the latter organization contracting for 200 hp. for five years at $600 per month for the first two years and $750 a month for the remainder of the term. The balance sheet of the Chichagof Mining Company shows cash and quick assets of $119,694; investments $1,153,748: and deferred charges $3,796.

Howe Sound Company reports the results of its operations for the quarter ending March 31, 1929, as follows:

Howe Sound Production

	Gold, Ounces	Silver, Ounces	Copper, Pounds	Lead, Pounds	Zinc, Pounds
First quarter 1929	3,454	700,446	10,314,981	20,456,992	17,317,282
Fourth quarter 1928	4,224	773,470	10,980,614	20,110,888	16,567,339

Financial

	First Quarter 1929	Fourth Quarter 1928
Value of metals produced	$4,450,583	$4,118,174
Operating costs	3,323,742	3,229,693
Operating income	$1,126,841	$888,480
Miscellaneous income	99,755	91,611
Total income	$1,226,596	$980,091
Less depreciation	236,312	225,578
Net income	$990,284	$754,513

N. Y. & Honduras Rosario 1928 Earnings Show Gain

NET PROFITS of New York & Honduras Rosario Mining, Central American silver producer, were $597,016 in 1928, compared with $439,446 in 1927. Factors contributing to the improvement recorded during 1928 were increased production, lower operating costs, and the higher average of silver price prevailing.

Income and Profit-and-Loss Statement

Production of gold and silver	$1,500,233	
Freight and expenses on bullion	57,946	
Operating income		$1,442,287
Operating expenses		867,906
Operating profit		$574,380
New York administrative expenses		66,387
Net profit from operations		$507,992
Miscellaneous income		165,969
		$673,962
Other deductions		40,886
Net profit before federal income tax and provision for reserves		$633,076
Federal income tax		36,060
Net profit for year		$597,016
Appropriated for reserves from earnings—		
Depletion (based upon valuation of mine at March 1, 1913)	$14,137	
Fire insurance	8,114	
Transit insurance	4,101	26,353
Profit for the year carried to surplus		$570,663
Surplus Jan. 1, 1928	$1,984,303	
Adjustment of 1928 depletion charges	628	
	$1,984,931	
Deductions		
Dividends paid and provided	$450,000	
Decrease during 1928 in market value of securities owned at Dec. 31, 1928	79,000	
Additional federal income tax — 1927	1,826	
Depletion (on appreciated mine valuation)	14,137	544,964 $1,439,967
Surplus Dec. 31, 1928		$2,010,630

Production in 1928 amounted to 2,275,103 oz. silver and 8,510 oz. gold, compared with 2,165,225 oz. silver and 5,584 oz. gold in 1927. The figures shown in this report are a close approximation only of the year's result: final and exact figures will be released later, the delay being caused by a fire at the company's office at San Juanito. Honduras.

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Calumet & Arizona-New Cornelia Merger Approved

Merger of the Calumet & Arizona Mining Company with New Cornelia Mining Company was formally completed on April 29. The new company will have a capitalization of $20,000,000 and will be known as Calumet & Arizona Mining Company. The consolidation, carried out under the laws of Delaware, is the largest merger of mining properties in Arizona since formation of the Phelps Dodge Corporation. Its capitalization represents an increase of $4,500,000, Calumet & Arizona's stock having been carried on its books at $6,500,000, and New Cornelia's at $9,000,000.

Miami Shows $1,536,841 Operating Profit for 1928

MIAMI Copper Company annual report reveals profit of $1,536,841 on its operations in 1928.

Operating Account for 1928

Revenue	$7,283,354
Development, mining and milling expenses	3,359,204
General expenses at mine	704,932
Freight, smelting, refining and selling expenses	1,505,396
Administration and legal expenses	176,979
Operating profit carried down	1,536,841
	$7,283,354

Production of copper during the year amounted to 48,259,448 lb., which was less than in 1927, a result of the higher percentage of oxidized copper minerals contained in the ore treated. This brought about an extraction of fewer pounds of copper per ton. Consequently, despite a most encouraging decrease in the cost of mining and treating a ton of ore, the cost per pound of copper was high. Most of the ore of this character has now been mined. The extraction of copper per ton of ore is now higher, and this improvement is expected to continue. Cost of producing copper in the months of January and February, 1929, was under 11½c. per pound, and it is confidently expected that this cost will be considerably decreased by improvements in operations resulting from the construction work now in progress.

The mill was operated at full capacity. Ore milled amounted to 4,260,599 tons, or an average of 11,835 tons per day for 360 days operated, assaying 0.853 per cent copper, of which 0.657 per cent was sulphide. Underground development was done to the amount of 84,619 ft., consisting of 52,543 ft. of drifts and 32,076 ft. of raises. To date, nine stopes, estimated to contain 8,645,606 tons, have been completely mined, with a tonnage extraction of 115.14 per cent and a grade, or assay, extraction of 88.71 per cent, resulting in a copper extraction of 102.14 per cent, the excess copper probably coming from overlying gob and side pillars not included in the estimate.

Cost of mining was reduced about 1c. per ton compared with the previous year, and remains a little higher than the average cost of mining to date, partly because of the fact that over 10 per cent more ore was undercut during the year than was drawn. There were no fatal accidents during the year, and the total time-lost-accidents rate was low, amounting to 0.703 accidents per 1,000 shifts, and 0.069 per 1,000 tons of ore mined and milled.

A somewhat larger tonnage was milled than during the previous year, with a reduction in cost of approximately 3c. per ton. The average grade of concentrate produced was raised from 34.26 per cent in 1927 to 38.36 per cent copper in 1928, representing a ratio of concentration of 65.7 to 1. Early in the year one section of the mill was equipped experimentally with three-stage grinding and new matless type flotation cells to serve as a pilot operation for complete remodeling and enlargement of the entire mill which is now in progress.

No new ore was developed during the year. General Manager Maclennan estimates that on Jan. 1, 1929, the ore reserves were as follows:

	Tons	Per Cent Total Copper	Per Cent Soluble Copper
Sulphide ore	95,397,981	0.88	0.09
Mixed ore	7,000,000	1.83	1.34

New construction in 1928 amounted to $865,519.03. During the year courses in vocational training were established as night schools and courses in foreman training were established as day schools in conjunction with other mining companies and the state and local educational systems, and a competent man was brought into the district as director of this work. The Miami Commercial Company, operating on a co-operative basis, distributed profits amounting to $121,460 to employees.

The cost of producing copper during the year was 11.9075c. per pound. Included in this cost is the amount of charges for repairs and renewals and upkeep of the plant of every nature. In addition, there has been a direct charge for depreciation of $418,228.

The average sales price for copper sold during the year was 14.9997c. per pound.

CONIAGAS MINES' annual report shows income of $146,000 for 1928, derived principally from interest on investments. Expenses for the year were $144,000. Coniagas is no longer an operating company, but is now primarily a holding and prospecting company. During 1928 considerable prospecting work was undertaken and an interest was acquired in Northern Aerial Minerals Exploration Company and Cyril Knight Prospecting Company. The company's largest investment is in Coniaurum Mines of Porcupine, of which it owns 61.6 per cent of the stock and 65.5 per cent of the $800,000 bond issue. Developments to the end of the year on the two lower levels did not bear out the expectations of the management, and results were disappointing. During the period of 1928 in which the mill was in operation, an average of 283 tons a day was treated, the average recovery being $4.81 a ton. After the end of the fiscal year the company was unable to meet its claims for wages and power, and upon application of the bondholders the company went into a receivership, F. D. Reid being appointed receiver and manager. Negotiations are under way in an effort to refinance the property and carry on development to greater depth. To accomplish this, however, some arrangements will have to be made to take care of the $800,000 bonds issue, the terms of the bond requiring that holders be paid off in cash.

Hollinger Report Shows Large Drop in Earnings

EVEN the most ardent supporter of Hollinger can hardly claim that the annual report for the year ending Dec. 31, 1928, is an optimistic statement. The principal changes in the report are a reduction of over $3,000,000 in profits; a decrease of over $9,000,000 in the ore reserves; a decline of 400,000 tons in the total of ore milled; a decrease of 58c. per ton in the average grade of the ore; and an increase of 60c. per ton in costs. The following statement compares the results of operations for 1928 with those for 1927:

	1927	1928
Tons milled	2,178,329	1,778,470
Average per day	6,001	4,982
Average grade of ore, per ton	$6.96	$6.28
Cost per ton	$3.44	$4.04
Value of bullion recovered	$14,548,899	$10,712,821
Operating profit	7,810,754	4,279,280
Value of ore reserves at end of year	60,225,539	51,210,235

During 1928 a large amount of development work was carried on below the 2,000 level, which showed most of the veins in place but also revealed a decrease in the grade of the ore which is reflected in decrease in the value of the ore reserves. The Schumacher shaft was sunk to the 3,950 level, and 250 ft. of crosscutting was completed by the end of the year. A vein carrying ore of satisfactory grade was indicated by diamond drilling 200 ft. south of the shaft. Some promising veins, the importance of which have not yet been determined, also were disclosed in other sections of the mine as a result of development work, particularly on the 2,600 level. The ore reserves at the end of 1928 total 6,557,322 tons, with an estimated per-ton value of $7.81.

Reference in the report is made to the Kamiskotia copper property, where the work done up until last April indicated 1,000,000 tons having a gross value of $8,700,000, taking copper at 14½c. a pound.

The company has taken up with the government the question of an extension of the railway into the Kamiskotia district, and, once a railway is assured, the management is prepared to build a concentrator and resume active developments. The balance sheet shows a surplus of $36,037,641, including investments of $11,473,269. Profit-and-loss statement shows bullion production amounting to $10,712,821 and other income and interest on investments of $752,146. Operating costs were $7,185,687, taxes $495,068, and depreciation $52,645, leaving a net operating profit of $3,731,566, to which was added $32,492 profit on sales of securities and $851,520 appreciation in value of shares in other companies. Dividends were paid to the amount of $5,412,000, which necessitated withdrawing $796,691 from surplus.

The Market Report

Metal Markets Continue to Mark Time—Copper Production Curtailed

New York, May 15, 1929—Little change has been evident during the last week, either in volume of sales or price, in the principal non-ferrous metal markets. The situation continues exceedingly quiet, with a pronounced trend toward hand-to-mouth buying as stocks in consumers' hands continue to dwindle. News of a curtailment in copper production, made public today, aroused great interest, but had no effect on the copper market.

Daily Prices of Metals

May	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
9	17.775	44.375	7.00	6.75	6.60@6.65
10	17.775	44.625	7.00	6.75	6.60@6.65
11	17.775	44.625	7.00	6.75	6.60@6.65
13	17.775	44.25	7.00	6.70@6.75	6.60@6.65
14	17.775	44.125	7.00	6.65@6.70	6.60@6.65
15	17.775	44.125	7.00	6.65@6.70	6.60@6.65
	17.775	44.354	7.00	6.721	6.625

Average prices for calendar week ending May 11, 1929, are: Copper, 17.775; Straits tin, 44.333; N. Y. lead, 7.000; St. Louis lead, 6.775; zinc, 6.619; and silver. 54.688.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; that is delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary form of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

May	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic	Spot	3M	Spot	3M	Spot	3M
	Spot	3M							
9	77⅞	75	84½	200⅝	202⅜	24 3/16	24 1/16	26 11/16	26¾
10	74¾	75	84½	201½	203¼	24¼	24 1/16	26 13/16	26 13/16
13	73	73	83¾	199	201¾	24⅛	24	26¾	26¾
14	71⅞	71¾	84	198¼	201	23 11/16	23 11/16	26¾	26¾
15	72⅜	71¼	83	199	201⅓	23 11/16	23 9/16	26 11/16	26 11/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

May	Sterling Exchange "Checks"	Silver		Gold London	May	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
9	4.84 5/8	54⅝	25 5/16	84s11½d	13	4.84 11/16	54⅜	25 3/16	84s11½d
10	4.84⅝	54⅜	25⅜	84s11½d	14	4.84 11/16	54⅜	25 3/16	84s10⅞d
11	4.84⅝	54⅜	25¼	.....	15	4.84 9/16	54⅜	25¼	84s11d

Average: Silver, 54.479c.; Sterling Exchange, 484.635c.

New York quotations are as reported by Handy & Hartman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Copper Still 18c.

This week has been similar to the six preceding weeks in copper, with sales confined to the custom smelters and limited to a few thousand tons. The large producers have accumulated a fair amount of orders waiting booking, but are not closing any of them for the present, and turning as much of the current business as possible over to the more urgent sellers. August shipment has been in greatest demand, with some May and June; all has gone at 18c., delivered Connecticut, or that basis.

Anaconda, Chile, and Andes today announced a 10 per cent curtailment in production. Some other companies have already taken steps in this direction or are contemplating doing so, as the increase that has been made in production rates seems a little more than is now necessary if consumption tapers off, as the recent quiet buying market would indicate. However, refined stocks are expected to be built up to at least 100,000 tons, which will require a substantial margin of production above consumption for some months, so it would seem that the curtailment announced today is a constructive step toward the maintenance of the 18c. price level.

Trading in copper began on the New York Metal Exchange today, with sales at 16.60@16.75c., electrolytic basis, but as copper as low-grade as 94 per cent is deliverable under the Exchange contract, this market will not be used for trading between producer and consumer, but only as an opportunity for hedging or speculation in the metal. The price is not comparable to that quoted in the usual market.

Foreign business, although about twice as good as it was last month, is still exceedingly quiet, at the unchanged price of 18.30c., c.i.f. usual European destinations. The outcome of the reparations conference is likely to have an important effect on the export copper market.

Lead Market Softens

A distinctly easier tone has appeared in the lead market during the last few days. A continuation of poor demand and weakness in London lead prices are primarily responsible for the appearance of weakness in a situation that previously had given promise of sustained stability. The New York price remains at the level of the American Smelting & Refining Company's contract price, 7c. per pound. One small sale was reported at $1 per ton under the 7c. price, though the tonnage was not sufficient to be reflected in the average quotation. Total sales for the last week were even less than those of the preceding week, which were well below normal. This makes the eighth consecutive week of less than average buying.

The St. Louis market declined considerably from the 6.80c. level recorded last week, though a few small lots did change hands at that price this week. A fairly good tonnage sold as low as 6.65c. per pound yesterday, and a corresponding tonnage was sold at a similar price late today.

Corroding grades of lead continue to sell at a premium of $2 to $3 per ton.

Assuming that consumption is continuing at the same high rate recorded in the first quarter, it seems certain that considerable buying must appear soon, for consumers are, as yet, very poorly covered on the June position. If good-scale buying does not materialize in the near future, and London lead quotations continue to decline, further reduction in domestic prices seems inevitable.

No Interest in Zinc

Zinc has sold only in small volume again this week, with prices exhibiting a rather wide range, from the occasional carload of particular brands at 6.80c. to the 6.55c. level quoted by at least one seller for a round tonnage. A fair amount was marketed at 6.65c. The shipments in demand varied all the way from spot to July. There is no great pressure to sell in any great tonnage, and large producers still think that fundamental conditions justify higher prices, which they are holding out for, 6.80c., St. Louis, being their present idea of a satisfactory price. Spot carloads of high-grade are nominally 8c., delivered in the East.

Lifeless Tin Market

Business in Straits tin has been virtually at a standstill; in fact, a somewhat greater volume of business in Chinese and English 99 per cent tin, at about 1c. per pound under the Straits price, has been done in the last week than was reported in Straits. Nominal support from the London "group" has prevented an appreciable decline in price.

Silver Lower and Unsettled

The silver market has continued to decline during the week as a result of lower rates in China exchanges. India has shown little interest in the local market, although reports from abroad indicate that moderate buying orders have been received from that quarter. The tendency remains unsettled.

Mexican Dollars (old Mexican pesos): May 9th, 41⅛c.; 10th, 41¼c.; 11th, 13th, 14th, and 15th, 41c.

Foreign Exchange

Closing cable quotations on Tuesday, May 14, were: Francs, 3.90⅛c.; lire, 5.23⅝c.; and marks, 23.725c. Canadian dollars, ⅜ per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c.

ANTIMONY—Per lb., duty paid. New York: Chinese brands, 9c. per lb. for all positions. Cookson's "C" grade, spot, 14¾c.

BISMUTH—Per lb., New York, in ton lots, $1.70. Smaller lots, $1.85 and up.

CADMIUM — Per lb., New York: 80@95c. Active demand.

IRIDIUM—Per oz., $260@$265 for 98 @99 per cent sponge and powder.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 35c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $38@$40. Small lots bring up to $50. Nominal.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, reduced from $70 to $68 per oz. effective May 10. Transactions between dealers and refiners in the outside market are commonly reported at several dollars less.

QUICKSILVER — Per 76-lb. flask, $120@$121; foreign quicksilver sellers cutting prices sharply to undersell domestic metal. Small lots command the usual premiums.

Prices of Chromium, Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Titanium, Tungsten, Vanadium, and Zirconium are unchanged from the issue of May 4.

Metallic Ores

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Wolframite, $16; Western scheelite, $16.50 bid, none offered. Nominal.

Antimony, Chrome, Iron, Manganese, Tantalum, Titanium, Vanadium, and Zircon ores are unchanged from quotations in the May 4 issue.

Tri-State Prices Unchanged

Joplin, Mo., May 11, 1929

Blende	Per Ton
High	$46.60
Premium blende, basis 60 per cent zinc	$44.00@ 45.00
Prime Western, basis 60 per cent zinc	43.00@ 44.00
Table concentrates, 60 per cent zinc	41.00@ 43.00
Flotation concentrates, 60 per cent zinc	39.00@ 41.00
Average settling price, all zinc ore	43.73
Galena	
High	$93.70
Basis 80 per cent lead	90.00
Average settling price, all lead ore	91.33

Shipments for the week: Blende, 8,171; lead, 1,911 tons. Value, all concentrates the week, $531,910.

Production over the last three weeks was lowered 2,300 tons. Shipments dropped to the lowest point this year. Purchases were increased this week, indicating larger shipments next week. Prices of all grades of zinc and lead concentrate remained unchanged.

Several mills shut down last week, and more are reported closing down this week to prevent overproduction.

Platteville, Wis., May 11, 1929

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$46.75
Lead Ore	
Lead, basis 80 per cent	$90.00

Shipments for the week: Blende, 702 tons; lead, none. Shipments for the year: Blende, 12,816; lead, 640 tons. Shipments for the week to separating plants, 1,252 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, and Tripoli are unchanged from prices in the May 4 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic) Per lb., 4c. Market firm.

Antimony Oxide, Calcium Molybdate, Sodium Sulphate (Salt Cake), Sodium Nitrate, and Zinc Oxide are unchanged from prices in the May 4 issue.

Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or duty paid, port of entry, $105. Spiegeleisen, 19@21 per cent, $33@$34 f.o.b. furnace.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferrovanadium, Nickel Silver, and Yellow (Muntz) Metal are unchanged from prices in the May 4 issue.

Rolled Metals

Copper, Lead, Zinc, Monel Metal, and Nickel Sheets are unchanged from prices in the May 4 issue.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of May 4.

Iron, Steel and Coke

IRON—Per gross ton, Valley furnaces, Bessemer, $18.50@$19; basic, $18@$18.50; No 2 foundry, $18.50.

STEEL—Base prices per gross ton Pittsburgh, billets and slabs, $35@$36; plates, structural shapes, and soft steel bars, per 100 lb., $1.95.

COKE—Per gross ton, Connellsville furnace, $2.75@$2.85. Connellsville foundry, $3.75@$4.85. Byproduct coke, Ohio and Kentucky (Connellsville basis) $6.50; Buffalo and Detroit, $8.50@$9.

Mining Stocks—Week Ended May 11, 1929

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	144	135	135½	Mr.29,My.20 Q	1.75
Anaconda Cop., new	New York	119⅜	113½	113½		
Andes Copper	New York	56½	52½	52½	Mr.29, My.6 Q	0.75
Arizona Com	Boston	3½	3½	3½	Ja. 16, Ja. 31 SA	0.25
Calumet & Ariz	New York	135	132	133½	My.31, Je.17 Q	2.50
Calumet & Hecla	Boston	46	44	44½	My.31, Je.29 Q	1.00
Cerro de Pasco	New York	103½	100½	100¼	Ap.11, My. 1 Q	1.50
Chile Copper	New York	102	101	101	Je. 1, Je.28 Q	0.87½
Con. Coppermines	N. Y. Curb	13⅜	12⅜	12⅜		
Copper Range	Boston	25⅜	24½	24½	Mr.15, Ap.15 Q	0.50
East Butte	Boston	3½	3½	3½	Dec., 1919	0.50
Granby Con	New York	83½	82	82½	Ap.12, My.1 Q	1.75
Greene Cananea	New York	166½	155⅜	155⅜	Mr. 7, Ap. 1 Q	2.00
Howe Sound	New York	72	67½	67½	Mr. 30, Ap. 15 Q	1.00
Hudson Bay	N. Y. Curb	18⅜	18	18⅛		
Inspiration	New York	49⅞	48	48⅜	Mr.14, Ap. 1 Q	1.00
Isle Royale	Boston	25⅜	23⅜	24	My. 31, Je.29	0.50
Kennecott	New York	95½	87¼	89½	No. 30, Ja. 2 Q	2.00
Magma Copper	New York	73⅜	70	73⅜	Mr.30, Ap.16 Q	1.25
Mason Valley	N. Y. Curb	1⅛	1⅛	1⅛		
Miami Copper	New York	45	42	42½	My1, My15 Q	1.00
Mohawk	Boston	60⅞	59	59⅜	Ap. 30, Je. 1 Q	1.50
Mother Lode	New York	3⅞	3⅜	3⅜	De.14, De.31 SA	0.20
Nevada Con	New York	52⅜	48⅜	49⅜	Mr.15, Mr.30 Q	0.75
New Cornelia	N. Y. Curb	47⅛	45⅜	47⅛	Fe. 1, Fe. 18 Q	0.50
Noranda	N. Y. Curb	59	53⅜	56½		
Ohio Copper	N. Y. Curb	2⅛	2	2⅛	Sept., 1926	0.03
Old Dominion	Boston	12⅜	11⅛	11⅜	Dec., 1918	1.00
Phelps Dodge, new	N. Y. Curb	80⅜	78⅜	79½		
Quincy	Boston	38	37	38	March, 1920	1.00
Roan Antelope	N. Y. Curb	46½	45½	46½		
St. Mary's M. L.	Boston	36	33½	34½	Fe.25, Mr.12	2.00
Seneca Copper	New York	6½	6	6		
Shattuck Denn	N. Y. Curb	19½	17⅜	18⅜		
Sherritt-Gordon	Toronto	8.40	8.00	8.05		
Tenn. C. & C.	New York	20	19½	19½	Fe.28, Mr.15 Q	0.25
United Verde Ex	N. Y. Curb	18	17½	17⅜	Ap. 4, My. 1 Q	1.00
Utah Copper	New York			325	Mr. 15, Mr. 30 Q	3.00
Waite-Ack.-Mont	Toronto	4.50	3.75	4.25		
Walker Mining	Salt Lake	4.05	3.95	4.02½		
Wenden Copper	N. Y. Curb	2	1⅛	1⅛		
LEAD, ZINC, SILVER						
Ahumada Lead	New York	3	2⅛	2⅛		
Amer. Z. L. & S.	New York	37⅛	34⅛	36⅛	May, 1917	1.00
A. Z. L. & S., pfd.	New York	102	98⅛	102	Nov., 1920	1.50
Bingham Mines	Boston	62½	55	62	Mr.15, Ap.5	0.50
Bunker Hill & S.	N. Y. Curb	143	143	143	Ap.25, My.6 X	0.75
Butte Cop. & Zn.	New York	7⅛	6½	6⅛		
Butte Cop. Con.	Boston Curb	*53	*50	*51		
Butte & Sup.	New York	8	7	7⅜	Mr. 15, Mr. 30 Q	0.50
Callahan Zn-Ld.	New York	2⅛	2	2⅛	Dec., 1920	0.50
Chief Consol.	Salt Lake	3.55	3.35	3.35	Fe. 1, 1928 K	0.10
Consol. Ld. & Zn. "A"	St. Louis	17⅛	16⅛	16⅜	Ap.5, Ap.10	0.25
Constitution	Spokane	*32½	*30	*32		
Dayrock	Spokane	2.60	2.45	2.60	Mr.23, Mr.30	0.03
Dickens Consol.	Spokane	*6½	*5½	*6½		
Eagle-Picher	Cincinnati	18⅜	17⅞	17⅞	Mr.31, Ap.15 Q	0.20
Eagle-Pich., pfd.	Cincinnati			102	Jan. 15 Q	1.50
Erupcion	Boston Curb	*10	*10	*10	Ja. 1, 1928 Q	0.07½
Eureka Bullion	Salt Lake	1.09	*97	*98		
Eureka Lilly	Salt Lake			1.42½		
Eureka Standard	Salt Lake			5.00		
Evans-Wallower	N. Y. Curb	17	14⅛	16⅛		
Evans-Wal., pfd.	N. Y. Curb			84½	Mr.20, Ap.1 Q	1.75
Federal M. & S.	New York			245	Je., 1927	10.00
Fed. M. & S., pfd.	New York	99⅛	99⅛	99⅞	Fe. 21, Mr. 15 Q	1.75
Gladstone	Spokane	*14	*12½	*12½		
Golconda	Spokane	1.67	1.49	1.64	Mr.20, Ap.1 Q	0.02
Grandview	Spokane	*47	*40	*41		
Hecla Mining	N. Y. Curb	19	18⅛	18⅛	My.15, Je.15 Q	0.25
Highland-Surprise	Spokane	*15⅜	*12	*15		
Jack Waite	Spokane	*11½	*10½	*10⅜		
Kootenay Florence	Spokane	*14½	*13	*13		
Lucky Jim	Spokane	*15	*12½	*12½		
Lucky Tiger-C.	Kansas City	†5.50	†5.00		De.4, De.20 MX	0.12
Mexican Premier	Spokane	1.90	1.69	1.88		
National Lead	New York	150	145	145	Mr. 15, Mr. 31 Q	1.25
Natl. Lead, pfd. A	New York	140½	140	140	Mr. 1, Mr. 15 Q	1.75
Natl. Lead, pfd. B	New York	118	118	118	Ap. 19, My 1 Q	1.50
N. J. Zinc	N. Y. Curb			330	Ap.20, My. 10 Q	2.00
N. J. Zinc, new	N. Y. Curb	83⅜	80⅛	83⅛		
New Quincy	Salt Lake	2.42½	2.30	2.35	My.15, My.27 Q	0.10
Noble Five	Spokane	*67	*50	*55		
North Lily	Salt Lake	8.25	8.25	8.25	Jan. 20 Q	0.25
Park Bingham	Salt Lake	8 50	7.75	7.75		
Park Utah	New York	10	9⅛	9⅛	Mr. 19, Ap. 10 Q	0.20
Pend Oreille	Spokane	6.00	5.00	5.00		
Rico Argentine	Salt Lake	*37	*32	*34	No. 30, De. 15 Q	0.03
Ruth-Hope	Spokane	*36	*27	*33		
St. Joseph Lead	New York	71	66	66½	Ju. 8, Ju.20 QX	0.75
Sherman Lead	Spokane	*38	*36½	*37½		
Silver King Coa.	Salt Lake	14.00	13 50	13 50	Mr. 20, Ap. 1 Q,	0.25
Silversmith	Spokane	*16⅜	*15½	*16	Oct., 1926 Q	0.02
Sunshine Mining	Spokane	2.00	1.87	2.00	De. 20, BM	0.02
Tamarack-Custer	Spokane	*67	*58	*59	Sept., 1924	0.25
Tintic Standard	Salt Lake	14.00	13.75	13.87½	De. 23, Ja. 23 X	0.20
Tonopah Belmont	N. Y. Curb	*62½	*62½	*62½	Oct., 1925	0.05
Treadwell-Yukon	Toronto	13.00	11.75	12.00		
United Zinc Smg	N. Y. Curb	1⅛	1	1⅛		
Utah Apex	Boston	4⅜	4⅜	4⅜	May 15, June 1	0.25
Utah Met. & Tun	Boston	1⅛	1⅛	1⅛	Dec., 1917	0.30
Whitewater	Spokane	*90	*70	*70		
Yellow Pine	Los Angeles			*16	Dec., 1925 QX	0.04
GOLD						
Alaska Juneau	New York	7⅛	6	6⅛		
Barry-Hollinger	Toronto	*34	*31	*31		
Central Manitoba	Toronto	*48	*43	*45		
Coniaurum	Toronto			*45		
Cresson Consol.	N. Y. Curb	*81½	*75	*75	Mr.30, Ap.10 Q	0.02
Dome Mines	New York	10⅛	9⅜	10	Mr.30, Ap..20 Q	0.25
Golden Cycle	Col. Springs	†1.90	†1.87		Fe.15, Mr.1	0.04
Gold Hill	Toronto	*3½	*3	*3½		
Hollinger	Toronto	7.35	6.60	6.70	My.3, My.20 M	0.05
Homestake	New York	76½	76	76½	My.20, My.25 M	0.50
Kirkland Lake	Toronto.	1.05	*95	1.04		
Lake Shore	Toronto	26.95	26.20	26.35	Mr.1, Mr.15 Q	0.20
McIntyre-Porc	New York	18	17	18	My.1, Je.1 Q	0.25
Portland	Colo.Springs	†*12	†*10½		April, 1927	0.02
Rand Mines	New York	36	36	36	Fe. 21,'28 Am.Sh.	1.52
Siscoe	Toronto	*77	*75	*77		
Sylvanite	Toronto	1.70	1.60	1.60		
Teck-Hughes	Toronto	9.40	9.15	9.15	Ap. 7, My 1, O	0.15
Tom Reed	Los Angeles	*30	*15	*30	Dec., 1926	0.02
Unity Gold	N. Y. Curb	2	1⅛	1⅛		
Vipond Consol	Toronto	1.08	1.01	1.06	April, 1927	0.03
Wright-Hargreaves	Toronto	1.78	1.60	1.60	Oc. 16, No. 1	0.02½
Yukon-Alaska	N. Y. Curb			35⅛		
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	19	17⅛	19		
Castle-Trethewey	Toronto	*36	*35	*36		
Consol. Cortez	N. Y. Curb	*18⅛	*18⅛	*18⅛		
Dolores Esperanza	N. Y. Curb			1	July, 1923	0.05
Keeley	Toronto	*58	*51	*51	Mr.15, 1928	0.04
Mining Corp.	Toronto	4.50	4.25	4.35	De.14,De.31 SA	0.15
Montana-Idaho	Spokane	*15	*11½	*13		
N. Y. & Hond. Ros.	N. Y. Curb	18	18	18	Ap.17,Ap.27 QX	0.05
Nipissing	N. Y. Curb	3⅛	3	3⅛	Mr.30,Ap.20 Q	0.07½
Premier Gold	N. Y. Curb	2⅛	1⅞	2	Mr.14, Ap.4	0.06
Tonopah Exten	N. Y. Curb			*10	April, 1925	0.05
Tonopah Mining	N. Y. Curb	3⅛	3½	3⅛	Ap. 7, Ap. 20	0.07½
United Eastern	N. Y. Curb	*75	*50	*50		
Yukon Gold	N. Y. Curb	*75	*68⅛	*68⅛	June, 1918	0.02
IRON AND STEEL						
Bethlehem Steel	New York	112⅛	106	109½	Jl.19, Au.15 Q	1.00
Beth. Steel, pfd, 7%..	New York	119½	118	119	Je.1, Jl.1 Q	1.75
Cleveland-Cliffs	Cleveland	250	230	239⅛	Ap.15, Ap.25 Q	1.00
Colo. Fuel & Iron	New York	67⅛	65	66		
Colorado F. & I., pfd.	New York			133	My.10,My.25 Q	2.00
Great Northern Iron	New York	30	28⅛	29	Dec.15, K	2.00
Inland Steel	New York	91⅛	89⅛	89⅛	My.15, Jn. 1, Q	0.87½
Republic I. & S.	New York	99⅛	96½	97½	My. 11, Je. 1, Q	1.00
Republic I. & S., pfd.	New York	111	111	111	Je.12, Jl. 1, Q	1.75
Sloss-Sheffield S. & I.	New York	107⅛	105	106⅛	Mr. 11, Mr.20, Q	1.50
Sloss-Sheff. S. & I., pfd.	New York			110	Mr.20, Ap.1, Q	1.75
U. S. Steel, new	New York	184	180	182⅜		
U. S. Steel, pfd.	New York			142½	My. 4,My 29, Q	1.75
Virginia I. C. & C.	New York			23	Jan., 1924	1.50
Virginia I.C.& C., pfd.	New York			47½	Jl.16, 1928	SA2.50
MISCELLANEOUS						
Aluminum Co. of Am.	N. Y. Curb	260	250½	251½		
Alum.Co.of Amer., pf.	N. Y. Curb	108	106½	107½	Mr.15, Ap.1, Q	1.50
American Metal	New York	59½	56	56½	My.9, Je. 1 Q	0.75
Amer. Metal, pfd., 6%	New York	119½	119½	119¾	My.21, Je.1, Q	1.50
Amer. Sm. & Ref.	New York	109⅜	102⅜	104½	Ap.12, My.14 Q	1.00
Amer. & Sm. Ref., pfd.	New York	136½	135	136	My. 3, Ju. 1 Q	1.75
Ang. Ch. Nitrate	N. Y. Curb	42	37⅜	41⅞		
Asbestos Corp.	Montreal	13⅛	12⅛	12⅛	Jan. 1926	1.50
Asbestos Corp., pfd.	Montreal	40	39	39	De. 31, Ja. 15 Q	1.75
Consol. M. & S.	Montreal	421	405	415	De.31,Ja.15,SA	6.25
De Beers Consol.	New York			23	Ja. 19, Ja.26,	0.48
Federated Metals	N. Y. Curb	33	32⅜	32⅜	Mr.27, Ap.5 Q	0.75
Freeport Texas	New York	47½	44⅛	46½	Ap. 5, My. 1 Q	1.00
Int. Nickel Can.	New York	54⅛	51	51⅛	Mr.16, Mr.30 Q	0.20
Int. Nickel, pfd.	New York			121	Ap.2,My.1No.1Q	1.75
Newmont	N. Y. Curb	215½	205½	211	Mr.30, Ap.15 Q	1.00
Patiño M. & E.	New York	42	38⅛	40⅛	My. 31, Jn. 28	4s
So. America G. & P.	N. Y. Curb	2⅜	2⅛	2⅜		
Texas Gulf Sulphur	New York	81⅛	78⅛	79⅜	Mr.4, Mr.15 Q	1.00
U. S. Sm. R. & M.	New York	65⅜	61	62	Ap. 4, Ap. 15 Q	0.87½
U. S. Sm. R. & M., pfd.	New York	54⅛	53⅛	53⅛	Ap. 4, Ap. 15 Q	0.87½
Vanadium Corp.	New York	95⅜	91	91⅛	Fe.1, Fe. 15 Q	0.75

Toronto Standard Stock Exchange, Toronto, courtesy Arthur E. Moysey & Co.; Salt Lake Stock Exchange, courtesy J. A. Hogle & Co. and Logan & Bryan, New York; Standard Stock Exchange, Spokane, courtesy Pohlman Investment Company.

*Cents per share. †Bid or asked. Q, Quarterly. A. Annually. SA, Semi-annually. M, Monthly. BM, Bimonthly. FW, Four weeks. K, Irregular. I, Initial. R, Resumprion. X, Extra. The first data given is that of the closing of the books; the second that of the payment of the dividend.

LONDON QUOTATIONS—WEEK ENDED MAY 1, 1929

	High	Low	Last	Date	Amount
Alaska Mexican ($5)	20/—	20/—	20/—		
Alaska Treadwell (25)	62/6	62/6	62/6	Nov., 1926	4p.c.(d)
Aramayo Mines (25 frs.)	65/7½	65/—	65/—	May 1929	5p.c.(†)
Burma Corp (10 rupees)	17/6	16/10½	16/10½	Feb., 1929	7 annas*
Bwana M'Kubwa (5s)	19/1½	18/—	18/3		
Camp Bird (2s)	2/6	2/—	2/6	April, 1928	1½ p.c.
El Oro (£1)	4/10½	4/ 3	4/9	Nov., 1924	2½ p.c.*
Frontino & Bolivia (£)	9/—	9/—	9/—	Jan., 1929	3½ p.c.
International Nickel of Canada (Quoted in dollars with a fixed rate of $5 to the £1) (no par value)	$52½	$49	$51¼	Mar., 1929	20(c)
Mexican Corpn. (£1)	15/4½	13/3	14/6		
Mexican Mines of El Oro (£1)	4/9	4/1½	4/6	Dec., 1926	3½ p.c.*
Mount Isa (£)	47/6	46/3	46/10½		
N'Changa Copper Mining. (£1)	77/6	71/3	72/6		
Oroville Dredging (4s)	2/1½	2/1½	2/1½	Nov., 1928	31½ p.c.
Rhodesian Congo Border (£1)	132/6	111/3	115/—		
St. John del Rey (£1)	17/6	16/3	17/—	Apr., 1929	7½ p.c.
San Francisco Mines (10s)	36/10½	35/3	35/7½	Jan., 1929	25 p.c.
Santa Gertrudis (£1)	10/6	9/9	10/6	Jan, 1929	7½ p.c.
Selukwe (2s. 6d.)	6/10½	6/3	6/6	April, 1917	6⅔ p.c.
S. Amer. Copper (2s.)	2/10½	2/6	2/7½	Nov. 1917	75 p.c.
Tanganyika (£1)	63/—	58/9	61/3	July, 1928	5 p.c.
Union Miniere de Haut-Katanga (Brussels)	11,990	11,000	11,000	April, 1929	300.00 fr.(6)

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian frs. and free of taxation. (d) U. S. Dollars.